

Non-plume flood basalt volcanism before the emplacement of the Afar mantle plume head

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Abstract

The Ethiopia-Yemen flood basalts are spatially zoned with progressively lower TiO₂ lavas from near the Afar depression toward the margins. The timing and rate of emplacement of low TiO₂ (LT) lavas are poorly known compared with the ultra-high TiO₂ (HT₂) lavas. We measured two high-precision ⁴⁰Ar/³⁹Ar ages of 29.63 ± 0.14 and 30.02 ± 0.22 Ma (2σ) from basalts of the 2-km-thick LT lava sequence at the Afar plume head margin. Using our eruption age model constructed from our and previous ⁴⁰Ar/³⁹Ar ages with the paleomagnetic directions, we estimate that the LT lava eruption continued over Chrons C12r-C12n-C11r. The eruption of the plume head margin started earlier than the plume head axis emplacement in C12n. Also, the eruption rate was low at the margin, high at the axis. We estimate that the LT lavas are induced by the edge-driven convection, the result of a plume-lithosphere interaction, not a plume head.

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Key Points:

- We obtain two new $^{40}\text{Ar}/^{39}\text{Ar}$ ages for the low-Ti basalt from the Lima-Limo section of the Ethiopia–Yemen flood basalts
- Based on our eruptive age model, we correlate the Lima-Limo section to Chrons C12r to C11r
- We conclude that the non-plume low-Ti basalts erupted before the Afar plume high-Ti basalts because of the plume–lithosphere interaction

Abstract

The Ethiopia-Yemen flood basalts are spatially zoned with progressively lower TiO₂ lavas from near the Afar depression toward the margins. The timing and rate of emplacement of low TiO₂ (LT) lavas are poorly known compared with the ultra-high TiO₂ (HT2) lavas. We measured two high-precision ⁴⁰Ar/³⁹Ar ages of 29.63 ± 0.14 and 30.02 ± 0.22 Ma (2σ) from basalts of the 2-km-thick LT lava sequence at the Afar plume head margin. Using our eruption age model constructed from our and previous ⁴⁰Ar/³⁹Ar ages with the paleomagnetic directions, we estimate that the LT lava eruption continued over Chrons C12r-C12n-C11r. The eruption of the plume head margin started earlier than the plume head axis emplacement in C12n. Also, the eruption rate was low at the margin, high at the axis. We estimate that the LT lavas are induced by the edge-driven convection, the result of a plume-lithosphere interaction, not a plume head.

Plain Language Summary

The Ethiopia-Yemen Flood Basalts are the expression of a mantle plume erupting millions of km³ of basaltic lava in a geologically short period (1-3 million years (Myr)). Titanium concentrations in the flood basalts are zoned and named HT2, HT1, and LT basalts (from high to low Ti). The eruption timing and rate of the HT2 basalts are constrained with high precision, but those of the LT basalts remain ambiguous. Therefore, we measured two high-precision ⁴⁰Ar/³⁹Ar ages from LT basalts in the 2-km-thick Lima-Limo section, which erupted northwest of the Afar area. Based on our eruption age model constructed from ⁴⁰Ar/³⁹Ar ages and paleomagnetic directions, we estimate that the eruption of the LT basalts started earlier than the HT2 basalts that erupted in Chron C12n and lasted over at most ~2 Myr. The eruptive rate of the LT basalts (0.02-4.69 km³/yr) in the earliest interval was lower than that of the HT2 basalts (4-13 km³/yr). We may explain that this eruption feature by a thickness gradient in the lithosphere on the Afar mantle plume at that time.

1 Introduction

Understanding of the flood basalt eruptions is essential because it provides clues to past mantle plume activity. The Afar Plume formed the Afro-Arabian Large Igneous Province (AALIP) over three periods, the Eocene, Oligocene, and Miocene (Rooney, 2017), and is one of the freshest flood basalts on Earth. The most active emplacement of AALIP occurred in the Oligocene (e.g., Hofmann et al., 1997), called the Oligocene Ethiopian-Yemen Traps, and geochemical studies of the Oligocene flood basalts have clarified that basalts show zoning with Ti content (Pik et al., 1998). Low Ti tholeiitic lavas (LT, TiO₂: 1–3 wt%) occur in the western part, high Ti tholeiitic lavas (HT1, TiO₂: 2–4 wt%) in the eastern part, and ultra-high Ti transitional basalt/picrite lavas (HT2, TiO₂ 3–7 wt %) near the Afar triple junction (Fig. 1a) (Pik et al., 1998; Beccaluva et al., 2009; Natali et al., 2016; Rooney, 2017). HT2 lava has a high mantle potential temperature (Beccaluva et al., 2009; Natali et al., 2016). Since high ⁴He/³He ratios were reported from HT2 lava, it is thought to be of deep mantle origin, consistent with the plume hypothesis (Marty et al., 1996; Natali et al., 2016). Mantle seismic tomography also suggests that the Afar plume rises from the bottom of the lower mantle (French and Romanowicz, 2015; Boyce et al., 2021). The HT2 basalts are the earliest eruptions of the Oligocene Ethiopia-Yemen Traps and are estimated to have significantly high emplacement rates (Eid et al., 2021). However, the timing and

rate of the emplacement of LT lavas have not been uniquely determined, and their eruption rates remain ambiguous (Fig. 1b) (Ahn et al., 2021; Eid et al., 2021).

The Oligocene Ethiopia–Yemen Traps are one of the three volcanic pulses of AALIP from the Eocene to the Miocene (Rooney, 2017). In the Lima-Limo section of the Traps, one of the thickest LT basalt sections in northwestern Ethiopia (Fig. 1a), several studies on paleomagnetism and $^{40}\text{Ar}/^{39}\text{Ar}$ age estimated that its eruption duration is 0.8–1.5 million years or less (Myr) (Hofmann et al., 1997; Rochette et al., 1998; Coulié et al., 2003; Ahn et al., 2021). Hofmann et al. (1997) and Rochette et al. (1998) conducted a magnetostratigraphic and $^{40}\text{Ar}/^{39}\text{Ar}$ study of the Lima-Limo section of the Traps and interpreted that the main part of the Traps erupted at about 30 Ma in a short period of time, less than 1.5 Myr. They identified a R–N–R polarity sequence and correlated it with Chrons C11r–C11n or C11r–C10r in the Geomagnetic Polarity Time Scale (GPTS) of Heustis and Acton (1997) (Fig. 1b). Coulié et al. (2003) performed K/Ar and $^{40}\text{Ar}/^{39}\text{Ar}$ datings and improved the correlation of the magnetostratigraphy of Rochette et al. (1998) with GPTS of Cande and Kent (1995) (Fig. 1b). However, previous studies couldn't establish a unique magnetostratigraphic correlation with GPTS (Fig. 1b). Recently, seven magnetozones were identified from the Traps: R1–N1–R2–N2–R3–N3–R4, from the bottom to the top of the section (Ahn et al., 2021). These newly found magnetozones make unique correlations to GPTS more difficult. The reason for the lack of the unique magnetostratigraphic correlation of the Lima-Limo section in previous studies is that they did not construct any eruption age models using the $^{40}\text{Ar}/^{39}\text{Ar}$ ages, which should be based on a common standard age. Furthermore, it is necessary to use as many $^{40}\text{Ar}/^{39}\text{Ar}$ ages as possible in order to construct high-precision age models. Therefore, in this paper, we report new high-precision $^{40}\text{Ar}/^{39}\text{Ar}$ ages of lavas from the Lima-Limo section and combine them with previously reported $^{40}\text{Ar}/^{39}\text{Ar}$ ages and construct an age model to estimate the eruption timing and rate.

2 Geological Setting, Samples and Methods

2.1 Geological Setting

The Oligocene Ethiopia–Yemen Traps in the Lima-Limo section erupted at ~30 Ma (Hofmann et al., 1997; Rochette et al., 1998; Coulié et al., 2003), which was before the Afro-Arabian continental breakup (Bosworth et al., 2005). Continuous lava piles that erupted at ~30 Ma have also been found in other areas of Ethiopia (e.g., Prave et al., 2016; Lhuillier and Gilder, 2019; Eid et al., 2021). After the continental breakup, the Traps split into two parts, 90% in Ethiopia and 10% in the Arabian Peninsula (Fig. 1a). Currently, the area of the main part of the Traps in Ethiopia is ~600,000 km² (Mohr, 1983). The total lava thickness of the Lima-Limo section reaches ~2 km, and all lava flows are LT basalts. The total volume of the Oligocene Ethiopia–Yemen Traps is estimated to be 350,000 km³ (Mohr, 1983; Mohr and Zanettin, 1988). The lower part (<~2200 m) is characterized by thin lava flows (<10 m) and a gentle slope morphology. In contrast, the upper part (>~2200 m) consists mainly of thick lava flows (10–100 m), forming cliffs with clear breaks along flow contacts (Ahn et al., 2021). In the Oligocene Ethiopia–Yemen Traps consisting of a large range of compositions from low-Ti to high-Ti basalts, in particular, the eruption rate of HT2

basalt in the Waja section may have been higher than that of LT basalt in the Belessa and Lima-Limo sections (Eid et al., 2021).

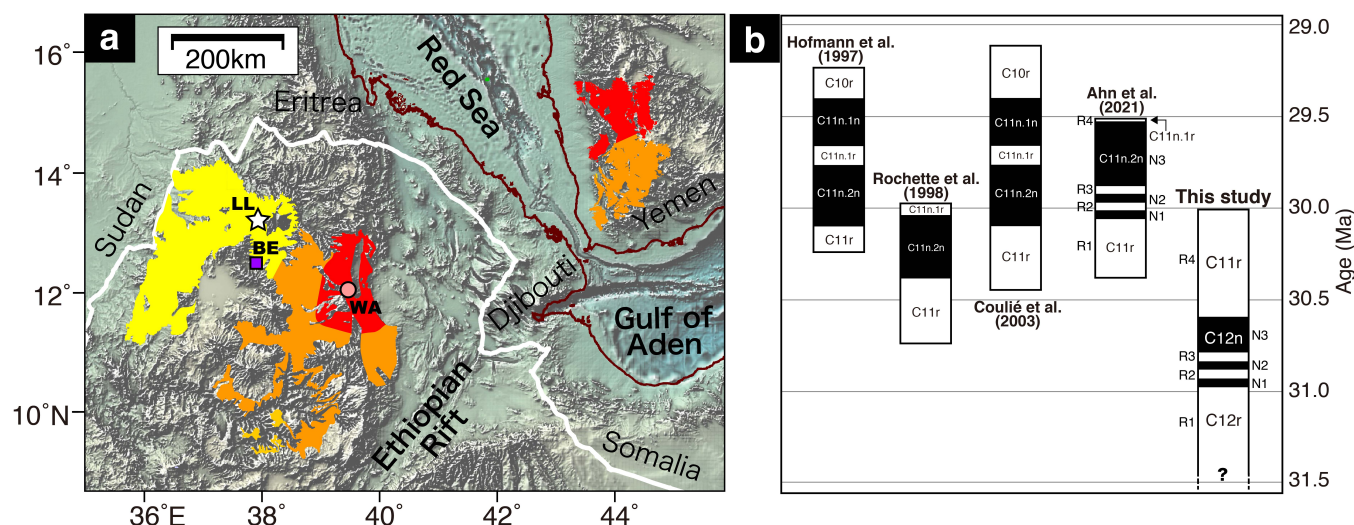


Figure 1. (a) Schematic map of the Oligocene Ethiopia–Yemen Traps (after Rooney, 2017). Section names are: Lima-Limo (LL, this study), Belessa (BE), and Waja (WA). Yellow, orange, and red colors show the spatial distribution of the basalt lavas of different titanium concentrations (Pik et al., 1998): LT, TiO_2 1–3 wt%, HT1, TiO_2 2–4 wt%, and HT2, TiO_2 3–7 wt%. The thick white line indicate the Ethiopian border. (b) Summary of previous and our magnetostratigraphic correlations of the Lima-Limo section. The reference GPTS are Cande and Kent (1995) for Hofmann et al. (1997), Huestis and Acton (1997) for Rochette et al. (1998), Cande and Kent (1995) for Coulié et al. (2003), Ogg et al. (2016) for Ahn et al. (2021), and Ogg (2020) for this study. When alternative age correlations were proposed in the previous studies, only the correlations preferred by the original authors in each study are presented here. We label the geomagnetic reversals in Chron C12n as the ‘Lima-Limo reversals’ and assumed that the Lima-Limo reversals are evenly distributed over the early half of Chron C12n.

2.2 Samples

We used the same LT lava samples as those in previous paleomagnetic studies (Fig. 1a, S1) (Yoshimura et al., 2020; Ahn et al., 2021). Before the dating experiments, we selected samples by inspecting thin sections to avoid contamination from secondary minerals. Photographs of the thin sections are shown in Fig. S2. Samples A1–61 and A2–162 are from two reversely magnetized lava flows belonging to the R4 magnetozone. Samples A2–482 and A2–604 are from the normally magnetized lava flows of the N3 and N1 magnetozones, respectively.

2.3 $^{40}\text{Ar}/^{39}\text{Ar}$ dating

We determined the ages of the basalt samples from the Lima-Limo section using the $^{40}\text{Ar}/^{39}\text{Ar}$ dating instrument at the Geological Survey of Japan, AIST. The details of the procedures are described in Ishizuka et al. (2018) and Text S1.

2.4 Eruption age model

We calculated Bayesian eruption age models using MacBacon 2.2 (Blaauw and Christen, 2011) and applied the following prior distributions: `acc.shape = 1.5`; `acc.mean = 500`; `mem.strength = 4`, `mem.mean = 0.7`, `thick = 125` (same as Sprain et al., 2019 except for the “thick”).

3 Results

Four samples were dated by stepwise heating analysis (Tables S1 and S2; Fig. 2a). Two samples (A1–61 and A2–162) yielded well-defined age plateaus comprising 82.7% and 82.1% of released gas, respectively (Tables S1 and S2; Fig. 2a). The inverse isochron ages for the two age spectra are identical to the weighted average ages of plateau-forming steps within 2σ error (Table S1, Fig. S3). These data indicate that the two plateau ages (29.63 ± 0.14 Ma for sample A1–61 and 30.02 ± 0.22 Ma for sample A2–162) (2σ , respectively) are reliable eruption ages of the basalts. A2–482 showed a partially disturbed age spectrum comprising 44.9% of released gas and did not have a plateau in a strict mean (Tables S1, S2; Fig. 2a). Sample A2–604 gave an age spectrum comprising 43.5% of the released gas and did not exhibit a plateau in a strict mean either (Tables S1 and S2; Fig. 2a). The age spectrum includes some apparent disturbance in low-temperature steps due to ^{39}Ar recoil (Schaen et al., 2020). Thus, we do not use the ages (samples A2-604 and A2-482) in our discussion.

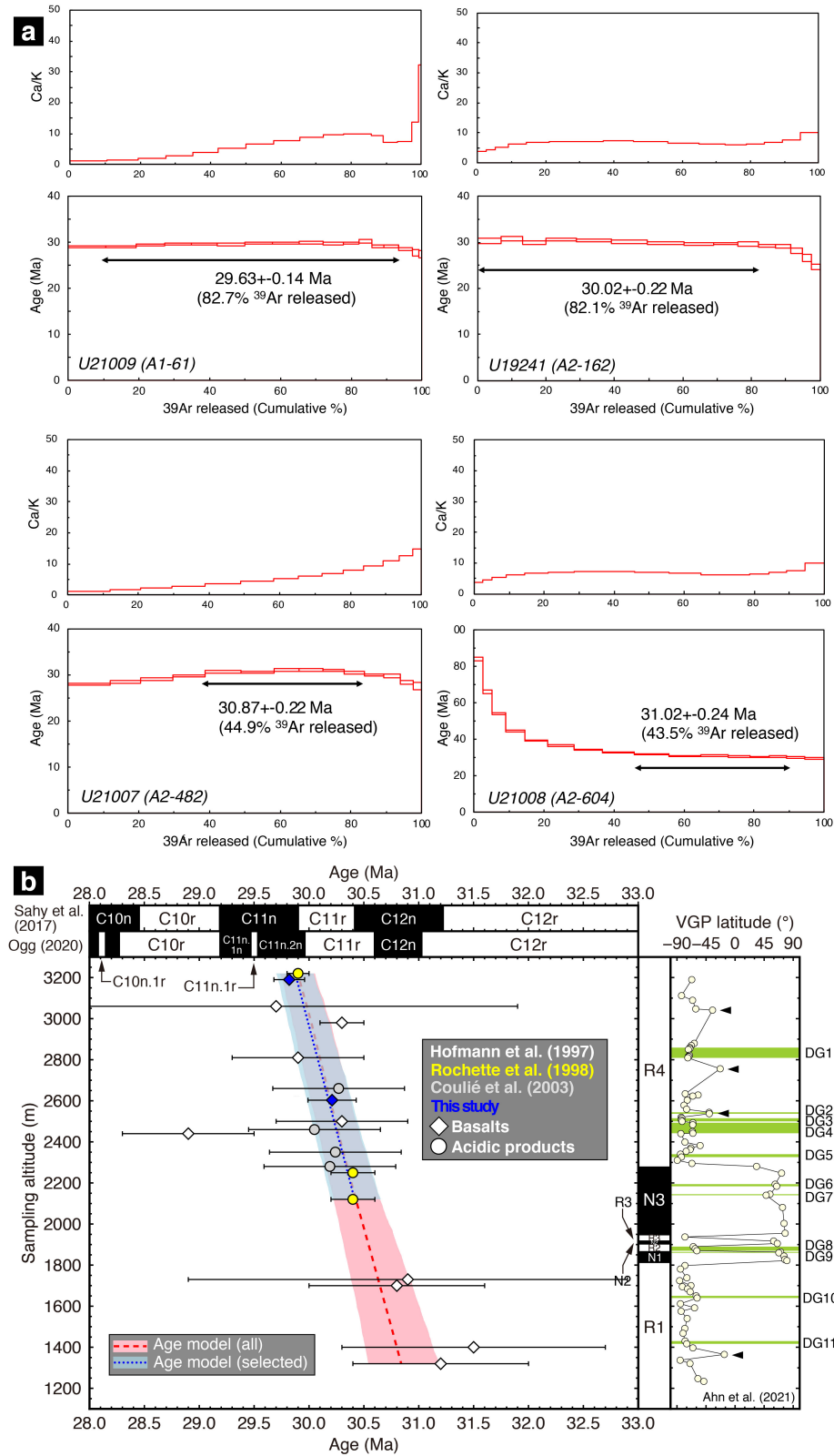


Figure 2. (a) $^{40}\text{Ar}/^{39}\text{Ar}$ age spectra and Ca/K plots for leached groundmass samples. Arrows indicate the steps forming plateau ages. $^{40}\text{Ar}/^{39}\text{Ar}$ plateau ages are shown with 2σ error. (b)

Bayesian eruption age models and compilation of our $^{40}\text{Ar}/^{39}\text{Ar}$ ages for the Lima-Limo section together with previously reported $^{40}\text{Ar}/^{39}\text{Ar}$ ages (Hofmann et al., 1997; Rochette et al., 1997; Coulié et al., 2003) with altitude (2σ error). The age model with the red dashed (blue dotted) line and the pink (light blue) area is for all ages (selected ages: this study and Rochette et al., 1998). The lines are averages of the age models, and the colored areas show 95% confidence intervals. Bayesian age model Bacon (Blaauw and Christeny, 2011) was used. All $^{40}\text{Ar}/^{39}\text{Ar}$ ages are recalibrated to the FCs standard with an age of 28.201 Ma (Kuiper et al., 2008) and the ^{40}K decay constant (Min et al., 2000). The Lima-Limo magnetostratigraphy, VGP latitudes, and paleomagnetic directional groups (DGs) (yellow green shaded boxes) (Ahn et al., 2021) (on the right) and two GPTS models (Ogg, 2020; Sahy et al., 2017) (on the top) are also shown. The black triangles indicate putative excursions Ahn et al. (2021) identified.

4 Discussion

4.1 Age correlation with geomagnetic polarity time scale

Here, we compare our high-precision groundmass-derived ages and the previously reported high-precision sanidine single-crystal-derived ages (Rochette et al., 1998) with the geomagnetic polarity ages of two GPTS models (Sahy et al., 2017; Ogg, 2020). The GPTS model of Ogg (2020) is the latest version of the GPTS. This GPTS model provides ages of geomagnetic reversal boundaries based on marine magnetic anomalies since the middle Mesozoic, which is constrained by astronomical tuning. The GPTS model of Sahy et al. (2017) was constructed by minimizing the discrepancy between the age-depth model based on U-Pb ages and the GPTS model of Ogg (2020). All $^{40}\text{Ar}/^{39}\text{Ar}$ ages here are recalibrated using the FCs standard with the age of 28.201 Ma (Kuiper et al., 2008) and the ^{40}K decay constant (Min et al., 2000) (Table S3). We can distinguish our two $^{40}\text{Ar}/^{39}\text{Ar}$ ages (samples A1-61 and A2-162 from the R4 magnetozone) at the 2σ level (29.82 ± 0.14 Ma and 30.21 ± 0.22 Ma, respectively). The age of sample A1-61 is correspond to Chron C11n.2n of GPTS2020, but this is not consistent with the polarity (Fig. 2b). In Sahy and other's GPTS model, the age of sample A1-61 is consistent with Chron C11r age at the 2σ level (Fig. 2b). The previous high precision sanidine single-crystal age of the sample LLC (29.9 ± 0.1 Ma) (recalibrated from Rochette et al., 1998) agrees with our age of sample A1-61 at almost the same elevation (~ 3200 m), indicating that our groundmass age has the similar accuracy and precision as the sanidine single-crystal age. Besides, the age of sample LLC agrees with Chron C11r of both GPTS models at the 2σ level (Fig. 2b) and the age of sample A2-162 agrees with Chron C11r of both GPTS models (Fig. 2b). Given these, we can interpret that all of the reversed polarity lava sequences at elevations between 2300 m and 3300 m (the R4 magnetozone) erupted in Chron C11r.

We can interpret that the Lima-Limo section erupted over Chrons C12r and C11r based on the eruption age models calculated from radiometric ages compiled from this study and previous studies (Fig. 2b, Table S4). This means that the Lima-Limo section erupted between 31.7 and 29.8 Ma (maximum estimation). The age model using our ages and the sanidine single-crystal ages of Rochette et al. (1998), which have high precision, agree with the age model constructed from all $^{40}\text{Ar}/^{39}\text{Ar}$ ages. This means that our ages and those of Rochette et al. (1998) contribute highly to the the age model constraints. The top of the age model constructed from all ages (3220 m) overlaps with Chron C11r of both GPTS models at the 95% confidence intervals, but it does not overlap with Chron C11n.1r of both GPTS models. This indicates that the lava flow of the magnetozone R4 erupted during Chron C11r. The N3–R4 magnetozone boundary of the age model constructed from all ages (2280 m) overlaps with the C12n–C11r boundary of the GPTS model of

Sahy et al. (2017) at the 95% confidence interval level, while it does not overlap with the boundary of Ogg (2020). The R1–N1 magnetozone boundary (1810 m) does not overlap with C12r–C12n boundary at the 95% confidence intervals of both GPTS models. This discrepancy suggests that the eruption rate around the R1–N1 magnetozone boundary may have been low. This possibility is consistent with the results that there are lava flows with intermediate paleomagnetic directions between the magnetozones N3 and R4, but not between R1 and N1 (Ahn et al., 2021). The bottom of the age model constructed from all ages (1330 m) overlaps with Chron C12r of the GPTS model of Ogg (2020) at the 95% confidence intervals, while it does not overlap with C12r of the GPTS model of Sahy et al. (2017). This indicates that the lava flow of the magnetozone R1 erupted during Chron C12r. In summary, the lava flows of the magnetozone R1 belong to Chron C12r, the those of the magnetozones N1 to N3 belong to Chron C12n, and the those of the magnetozone R4 belong to Chron C11r. We have uniquely correlated the Lima-Limo section to the GPTS for the first time.

We cannot correlate the short-lived reversed-polarity lava flows, R2 and R3 magnetozones (‘Lima-Limo reversals’), to Chron C12n of both GPTS models because Chron C12n does not include cryptochrons or excursions on the current GPTS. We now consider two possibilities for these reversed-polarity magnetozones. The first possibility is that we identified four new geomagnetic reversals within Chron C12n that have not been previously detected from marine magnetic anomalies (Cande and Kent, 1992). In this case, there would be a short reversal polarity in Chron C12n that has not yet been registered in GPTS. In the Waja section that erupted in Chron C12n (Eid et al., 2021), intermediate paleomagnetic directions were reported from six lava flows. The six lava flows are located in the lower part of the Waja section, which suggests that the paleomagnetic direction in early C12n is unstable. This finding is consistent with the R2 and R3 magnetozones found in the Lima-Limo section. A relative paleomagnetic intensity low in the early C12n observed in Oligocene marine sediments (Yamazaki et al., 2013; Yamamoto et al., 2014) may reflect the Lima-Limo reversals, suggesting that this is a global event. In addition, the absolute paleointensity decrease was observed in the N1 magnetozone (Yoshimura et al., 2020). Thus, we interpreted that geomagnetic reversals occurred in early Chron C12n. The second possibility is that the lavas in the R2 and R3 magnetozones are intrusive rocks formed at different times than the upper and lower lava. When we conducted the field survey at the Lima-Limo section, however, we did not find any dyke or sill in the lava outcrops (Fig. S1). Therefore, we consider that the geomagnetic reversals of the R2 and R3 magnetozones reflect the geomagnetic field behavior in early Chron C12n.

4.2 Estimation of emplacement rate

We calculate the eruption rate for each chron to calculate the eruption rate using the volume of 150000 km³ of tholeiitic basalt in the LT basalt zone estimated in a previous study (Beccaluva et al., 2009). This is about 20% of the total volume of the Ethiopia–Yemen Traps (Rooney, 2017) of 720000 km³. In this case, the volume of magnetozone R4 is calculated to be 71484 km³, N1 to N3 is 31524 km³, and R1 is 46992 km³. We assume that the maximum eruption durations are as follows: 0.621 Myr (Ogg, 2020) or 0.50 Myr (Sahy et al., 2017) for the R4 magnetozone (Chron C11r), 0.386 Myr (Ogg, 2020) or 0.82 Myr (Sahy et al., 2017) for the N1 to N3 magnetozone, and 2.237 Myr (Ogg, 2020) or 1.86 Myr (Sahy et al., 2017) for the R1 magnetozone. Based on these maximum durations, the eruption rates are calculated as 0.02 to 0.03 km³/yr for the R1 magnetozone, 0.04 to 0.08 km³/yr for the N1 to N3 zone, and 0.12 to 0.14 km³/yr for the R4 magnetozone, respectively (Table S5). Note that it is unclear when the eruption of the R1

magnetozone began. According to our age model, the lavas of the magnetozone R1 are likely to start eruption in late Chron C12r (Fig. 2b). However, this inference is not precise enough to calculate the eruption rate of the R1 magnetozone. Therefore, it is also necessary to estimate the eruption rate in the paleomagnetic directional groups (DGs).

To determine the net duration of the eruptive period of the Lima-Limo section, we use the results of the analysis of paleomagnetic secular variations recorded in the section (Ahn et al., 2021). Ahn et al. (2021) used the method proposed by Mankinen et al. (1985) and the statistical test of McFadden and Lowes (1981). They then grouped the statically same directions and assigned 11 DGs. However, site-averaged directions with α_{95} exceeding ten were used for two DGs, so only nine DGs are used in this study. We assume that the rate of geomagnetic secular variations in the last 3000 years ($\sim 2^\circ/100$ years, Chenet et al., 2008) and that in the Lima-Limo section are the same. Because lava flows record the ambient geomagnetic direction during cooling, we can infer whether the paleomagnetic directions of successive lava flows were separated by long time intervals using paleomagnetic secular variations. Lava flows separated by long time intervals usually have significantly different mean paleomagnetic directions, but when erupted successively within a short time interval, such as 100 years, they are statistically indistinguishable. If the mean directions of adjacent lava flows are statistically indistinguishable at the 95% confidence level, the lava flows are considered to have been rapidly emplaced and failed to record paleomagnetic secular variations. Their paleomagnetic directions are merged into a single DG (Chenet et al., 2008). We assumed the upper and lower limits of lava eruption time for individual DGs as 100 years and ten years, respectively, and the interval of lava flows that have distinct paleomagnetic directions as at least 500 years (Chenet et al., 2008). In this case, for the entire Lima-Limo section, the eruption period of the R1 magnetozone corresponding to Chron C12r is $2 \times 10 (100) + 20 \times 500 = 10020$ (10200) years at least (at most). Through the same calculation manner, that of the N1 to N3 magnetozones is 7010–7100 years, and that of the R4 magnetozone is 11550–12000 years. The eruption rates can be estimated to be 4.61–4.69 km³/yr for the magnetozone R1, 4.44–4.50 km³/yr for the magnetozones N1 to N3, and 5.96–6.19 km³/yr for the magnetozone R4, respectively (Table S5). Note that the relatively high eruption rate of the magnetozone R4 would be slightly overestimated because sampling densities were sparse due to poor exposures at ~ 2640 – 2740 and ~ 2900 – 3040 m and entrance restrictions at 3120–3260 m (Ahn et al., 2021). Nevertheless, these rates are lower than the previous estimation for HT2 lavas (4–13 km³/yr: Eid et al., 2021).

4.3 Edge-driven convection to induce partial melting of ambient (non-plume) asthenosphere

The HT2 lavas reported in a previous study (Pik et al., 1998) are thought to represent the mantle plume axis (Natali et al., 2016). The HT2 lava flows were the first zone to erupt in three titanium zones and had the highest emplacement rate of 4–13 km³/yr in the Oligocene Ethiopia–Yemen Traps, which is thought to be the Afar plume head expression (Eid et al., 2021). The HT1 zone shows a circular pattern around the HT2 zone (Fig. 1a) (Beccaluva et al., 2009; Natali et al., 2016). The mantle potential temperatures of each zone are consistent with the expected plume head temperature distribution (Beccaluva et al., 2009; Natali et al., 2016). However, we found that the LT lavas erupted earlier than the HT2 lavas and had a lower eruption rate than the HT2 lavas (Fig. 3a, b). In other words, the LT zone would have been the first eruption in the Oligocene Ethiopia–Yemen Traps, even though it was not on the plume head axis. Additionally, the emplacement rate of the LT lavas was lower than that of the HT2 lavas. Given that the Lima-Limo and Belessa section, the eruption period of the LT lavas (Chron C12r to C11n.1n) appears to have been

significantly longer than that of the HT2 lavas (Chron C12n) (Fig. 3a). These results are contrary to the geodynamic model which predicts that the first stage of the plume eruption is the most vigorous. If the plume head collides with a lithosphere with a simple structure, then eruptions caused by the plume head should be spatially simultaneous. However, this is not the case in the Afar region.

We propose that this discrepancy in eruption timing was caused by the interaction of the Afar plume with the lithospheric basement topography. The first scenario is that a part of the plume reached the near-surface earlier than the plume head axis. When there is a gradient of the lithospheric thickness (i.e., lithospheric step), the plume would flow and rise along the lithospheric step from a thicker part to a thinner part (e.g., Thompson and Gibson, 1991; Ebinger and Sleep, 1998; Gorczyk et al., 2018). In the Afar plume case, we assume that the lithosphere under the LT zone was thin, and the lithosphere under the HT2 zone was thick. It is difficult to verify the lithospheric step under the Afar basement that once may have existed because the lithospheric thickness at present is considered to have been increased by the Afar plume accretion. Nonetheless, this is possible because the lithospheric thickness can have large spatial variations (e.g., Globig et al., 2016). After the Afar plume collided with the lithosphere, a part of the plume flowed into the thinner lithosphere under the LT zone (Fig. 3c–e). This induced decompression melting of the asthenosphere to produce the HT magma. However, little plume signals have been found in the LT lava (Marty et al., 1996; Pik et al., 2006). Thus, the flood basalts in the LT zone may not be explained by the decompression melting of the plume head. The second scenario is that edge-driven convection occurred when the Afar plume rose (Fig. 3f–h). Edge-driven convection is an asthenospheric small-scale convective instability caused by lithospheric steps (e.g., King and Anderson, 1998). Numerical simulations suggested that edge-driven convection presumably occurred at a lithospheric step near the plume before the collision of the plume at the lithosphere–asthenosphere boundary (Duvernay et al., 2022); when a lithospheric step between the LT and HT2 zones was present, edge-driven convection would have induced partial melting of the ambient (non-plume) asthenosphere to produce LT magma (Fig. 3g). Also, this scenario is consistent with little plume signal found in the lavas of the LT zone. Furthermore, we can explain the lower emplacement rate of the LT lavas than that of the HT2 lavas because the emplacement was not caused by the impact of the main body of the plume head (Fig. 3b). This scenario can successfully explain the absence of LT lavas in the eastern part of the East African Main Rift and the Yemen area (Pik et al., 1998) and the asymmetric shape of the Afar plume (Beccaluva et al.,

2009). The interaction between the mantle plumes and the continental lithospheric geometry in the scenario may occur universally when a plume rises.

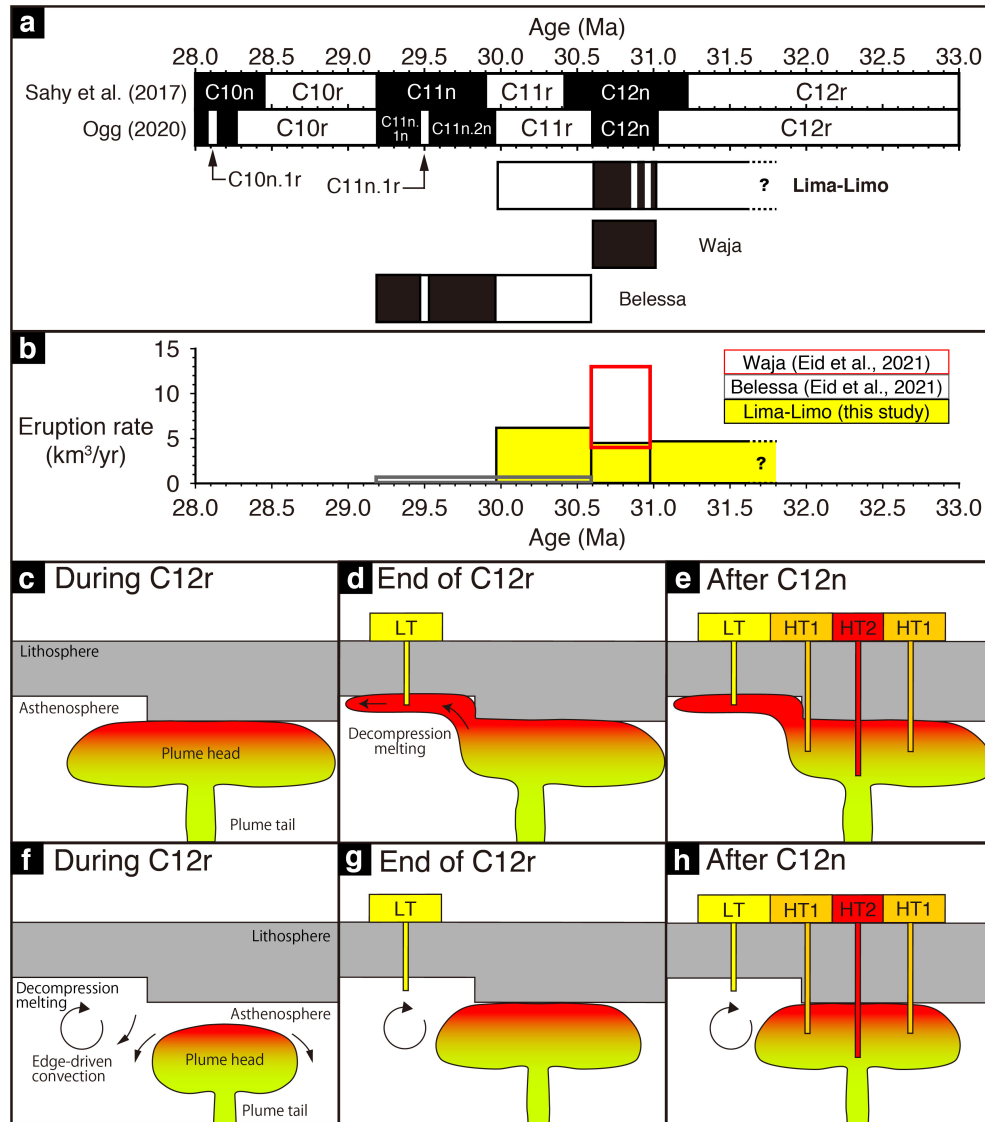


Figure 3. (a) Emplacement order of the Lima-Limo, Waja, and Belessa sections with the geomagnetic polarity time scales (Sahy et al., 2017; Ogg, 2020). (b) Eruption rates of each section. (c–e) Schematic illustration of the Afar plume rise and emplacement of the Traps by the decompression melting. (c) The Afar plume collides with the lithosphere. (d) A part of the Afar plume flows into the thinner lithosphere. The part of the plume rises along the lithosphere, which causes decompression melting. (e) Subsequently, the hot plume head center melts, which forms the HT1 and HT2 basalts. We assume that HT1 and HT2 erupted simultaneously. (f–h) Schematic illustration of the Afar plume rise and emplacement of the Traps by edge-driven convection. (f) When the Afar plume approaches the surface, edge-driven convection occurs near a lithosphere step. Edge-driven convection causes decompression melting of ambient (non-plume) asthenosphere. (g) The decompression melting produces the first magma of the Oligocene Afar

plume, the LT lavas. (h) Subsequently, the hot plume head center melts, which forms the HT1 and HT2 basalts.

5 Conclusion

We conclude that the Oligocene Ethiopia–Yemen Traps in the Lima-Limo section erupted over Chrons C12r–C12n–C11r considering new high-precision $^{40}\text{Ar}/^{39}\text{Ar}$ ages and previously reported $^{40}\text{Ar}/^{39}\text{Ar}$ ages. The four geomagnetic reversals observed in the Chron C12n lava flow may be short geomagnetic reversals within Chron C12n. The LT lavas in the Lima-Limo section emplaced before the main pulse of Afar magmatism, the eruption of the HT2 lavas. The eruption rate of the Lima-Limo section was lower than that of HT2 lavas. Since little plume component is detected for the LT lavas, we suggest that the partial melting of ambient (non-plume) asthenosphere to produce the LT magmas was induced by edge-driven convection in the asthenosphere, which occurred before the plume head reached the lithosphere.

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Data Availability

All new data used in the figures are included in supporting information files. The $^{40}\text{Ar}/^{39}\text{Ar}$ data will be available at the Kyushu University Institutional Repository (QIR) before the publication.

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[Geophysical Research Letters]

Supporting Information for

[Non-plume flood basalt volcanism before the emplacement of the Afar mantle plume head]

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Contents of this file

Text S1, Figures S1 to S3

Additional Supporting Information (Files uploaded separately)

Captions for Tables S1 to S5

Introduction

[This dataset contains results of field photos, thin section observations, ⁴⁰Ar/³⁹Ar age spectra, inverse isochron plots]

Text S1. $^{40}\text{Ar}/^{39}\text{Ar}$ dating

We analyzed 7.3-8.8 mg of phenocryst-free groundmass using a step-wise heating procedure, which was crushed and sieved to 250-500 μm in size. We prepared groundmass grains using the SELFRAG Lab system at the National Museum of Nature and Science, Tsukuba. We treated the samples in 6N HCl for 30 minutes and then 4N HNO_3 for 30 minutes at 95°C with stirring to clean up any secondary products (clays and carbonates) existing in interstitial spaces. After the treatment, we removed microphenocrysts of clinopyroxene in the samples under a microscope. Sample irradiation was done at the reactor of the Institute for Integrated Radiation and Nuclear Science, Kyoto University for four hours. We used sanidine separated from the Fish Canyon Tuff (FC3) for the flux monitor and assigned it an age of 27.5 Ma, which was determined against our primary standard for our K-Ar laboratory, Sori biotite, whose age is 91.2 Ma (Uchiumi & Shibata, 1980).

We used a CO_2 laser heating system (NEWWAVE MIR10-30) at continuous wave mode for sample heating. We used a faceted lens in order to obtain a 3.2 mm-diameter beam with homogenous energy distribution to ensure uniform heating of the samples during stepwise heating analysis. We measured argon isotopes on an IsotopX NGX noble gas mass spectrometer fitted with a Hamamatsu Photonics R4146 secondary electron multiplier in a peak-jumping mode.

Errors for $^{40}\text{Ar}/^{39}\text{Ar}$ results are reported at one standard deviation (1σ) in Fig. S3, Tables S1 and S2. In the main text, errors are reported at two standard deviations (2σ). Errors for ages include analytical uncertainties for Ar isotope analysis, correction for interfering isotopes and J value estimation. We achieved correction for interfering isotopes by analyses of CaF_2 and KFeSiO_4 glasses irradiated with the samples. We assigned an error of 0.5% to J values as a pooled estimate during the course of this study. Results of Ar isotopic analyses and correction factors for interfering isotopes are presented in Table S2.

We calculated plateau ages as weighted means of ages of plateau-forming steps, where each age was weighted by the inverse of its variance. We determined the age plateaus following the definition by Fleck et al. (1977). We calculated inverse isochrons using York's least-squares fit, which accommodates errors in both ratios and correlations of errors (York et al., 2004).

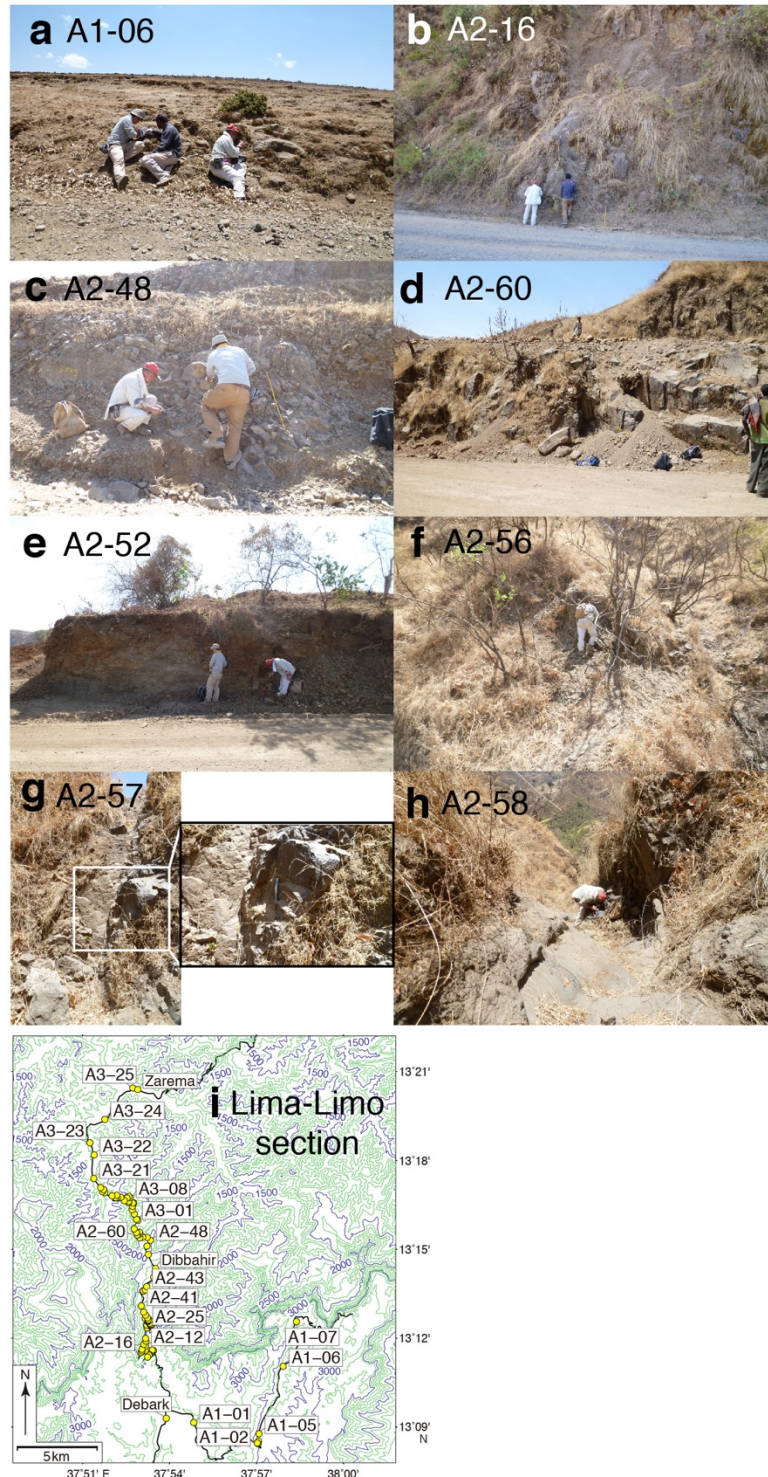


Figure S1. (a-h) Field photograph of basaltic flow at site A1-06, A2-16, A2-48, A2-60, A2-52, A2-56, A2-57, A2-58. (i) Route map of the sampling sites (solid yellow circles) in the Lima-Limo section.

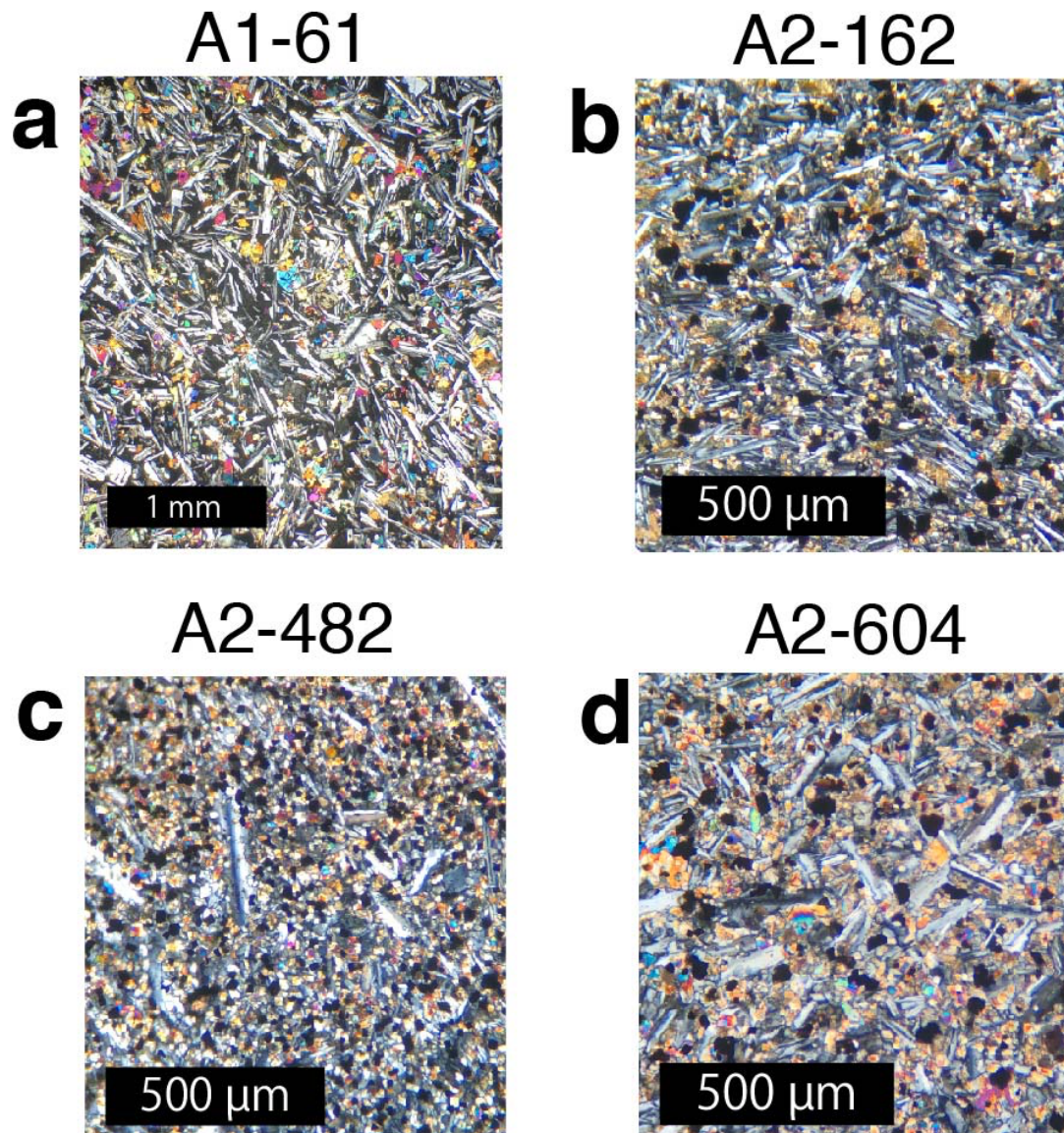
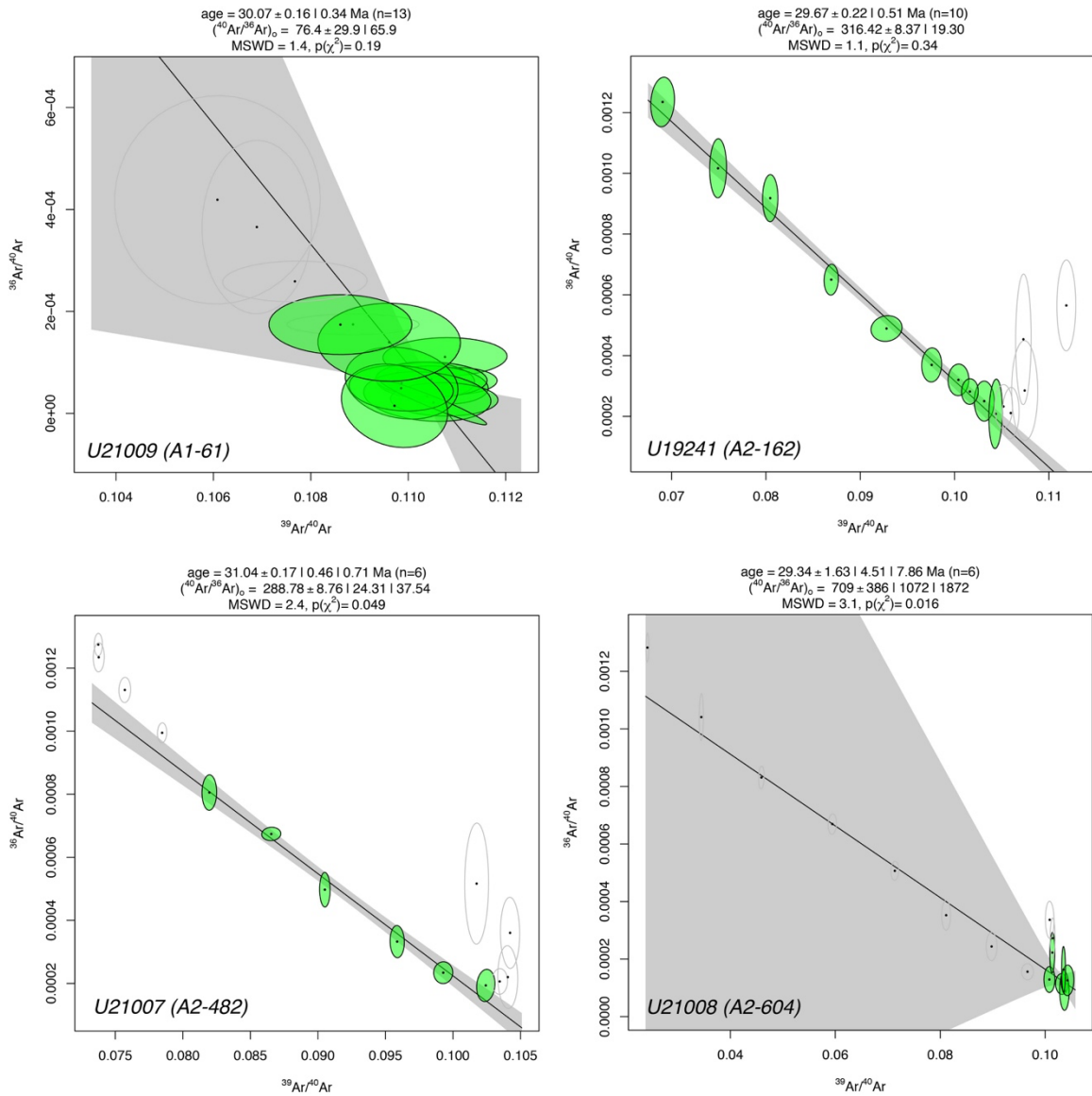


Figure S2. (a-d) Thin section of samples A1–61, A2–162, A2–482, and A2–604 (crossed nicols), which are samples from the lava flows where $^{40}\text{Ar}/^{39}\text{Ar}$ datings were conducted in this study. There are (a) crystalline groundmass and (b-d) fine grain groundmass with plagioclase phenocrysts and microphenocrysts of opaque minerals.

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74 **Figure S3.** Plots of the inverse isochrons are plotted from each respective $^{40}\text{Ar}/^{39}\text{Ar}$
 75 experiment. Solid black lines are the best estimated inverse isochrons. Ovals express 1-sigma
 76 error ellipses for each incremental heating step.

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81 **Table S1.** Results of stepwise-heating analyses of leached groundmass of volcanic rocks from
82 the Oligocene Ethiopian Traps.
83

84 **Table S2.** Results of isotopic analysis for $^{40}\text{Ar}/^{39}\text{Ar}$ dating.
85

86 **Table S3.** Recalibrated $^{40}\text{Ar}/^{39}\text{Ar}$ ages of this study and previous studies for the Lima-Limo
87 section.
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89 **Table S4.** Results of eruption age models calculation using model bacon.
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91 **Table S5.** Eruption rates of each section in Ethiopia flood basalts.
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Table S1 Results of stepwise-heating analyses of leached groundmass of volcanic rocks from the Oligocene Ethiopian Traps.

Irradiation No.	Analysis No.	Sample No.	steps	Total age ($\pm 1\sigma$)	Plateau age ($\pm 1\sigma$)				
				integrated age (Ma)	weighted average (Ma)	inv. isochron age (Ma)	$^{40}\text{Ar}/^{36}\text{Ar}$ intercept	MSWD	fraction of ^{39}Ar (%)
KUR1804	U19241	A2-162	15	29.71 $\pm$ 0.10	30.02$\pm$0.11	29.67 $\pm$ 0.22	316 $\pm$ 8	1.10	82.1
KUR2002	U21008	A2-604	16	36.24 $\pm$ 0.08	31.02$\pm$0.12	29.4 $\pm$ 1.6	709 $\pm$ 386	3.10	43.5
KUR2002	U21009	A1-61	17	29.48 $\pm$ 0.05	29.63$\pm$0.07	30.07 $\pm$ 0.16	76 $\pm$ 30	1.40	82.7
KUR2002	U21007	A2-482	14	29.81 $\pm$ 0.07	30.87$\pm$0.11	31.04 $\pm$ 0.17	289 $\pm$ 9	2.40	44.9

inv. isochron age: inverse isochron age.

MSWD: mean square of weighted deviates ((SUMS/(n-2))^{0.5}) in York (1969).

Integrated ages were calculated using sum of the total gas released.

$\lambda_b = 4.962 \times 10^{-10} \text{ y}^{-1}$, $\lambda_e = 0.581 \times 10^{-10} \text{ y}^{-1}$, $^{40}\text{K}/\text{K} = 0.01167\%$ (Steiger & Jager 1977).

Atmospheric $^{40}\text{Ar}/^{36}\text{Ar}$: 295.5

Table S2. Results of isotopic analysis for $^{40}\text{Ar}/^{39}\text{Ar}$ dating

Laser output	⁴⁰ Ar(±1σ)	³⁹ Ar(±1σ)	³⁸ Ar(±1σ)	³⁷ Ar(±1σ)	³⁶ Ar(±1σ)	days after irradiation	K/Ca	⁴⁰ Ar* (%)	³⁹ Ar/K _X fraction (%)	⁴⁰ Ar*/ ³⁹ Ar _X (±1σ)	Age(±1σ) (Ma)	adoption as plateau		
sample ID	A2-482	Analysis ID:	U21007	Irradiation ID:	KUR2002									
J=	0.0018513													
1.44W	605776 ± 535	44669 ± 63	242.97 ± 13.34	34175 ± 178	772.0 ± 8.8	48.54	0.769	62.3	12.0	8.45 ± 0.06	28.02 ± 0.24	n		
1.5W	434436 ± 523	32049 ± 61	144.69 ± 13.20	30440 ± 106	536.2 ± 8.2	48.56	0.619	63.5	8.6	8.61 ± 0.08	28.54 ± 0.30	n		
1.62W	445617 ± 534	33734 ± 68	138.50 ± 10.34	42679 ± 127	503.8 ± 7.2	48.57	0.465	66.6	9.0	8.80 ± 0.07	29.14 ± 0.27	n		
1.74W	438189 ± 489	34382 ± 48	121.63 ± 11.77	55143 ± 160	435.9 ± 5.6	48.60	0.367	70.6	9.2	9.00 ± 0.05	29.81 ± 0.23	n		
1.88W	464113 ± 705	38039 ± 85	79.46 ± 15.16	79205 ± 280	373.8 ± 10.7	48.61	0.263	76.2	10.2	9.30 ± 0.06	30.79 ± 0.33	y		
2.025W	402419 ± 692	34928 ± 100	67.74 ± 20.46	89535 ± 232	271.2 ± 3.5	48.63	0.229	80.1	9.3	9.25 ± 0.04	30.64 ± 0.21	y		
2.16W	292865 ± 260	26508 ± 40	27.69 ± 15.66	80609 ± 226	145.6 ± 6.6	48.64	0.193	85.3	7.1	9.42 ± 0.08	31.21 ± 0.29	y		
2.325W	2959378 ± 199	24866 ± 53	20.06 ± 7.68	87869 ± 155	86.3 ± 5.4	48.67	0.166	90.2	6.7	9.41 ± 0.07	31.14 ± 0.27	y		
2.535W	224247 ± 292	22263 ± 58	29.69 ± 7.94	90494 ± 118	52.5 ± 3.2	48.68	0.145	93.1	6.0	9.38 ± 0.05	31.05 ± 0.23	y		
2.805W	208582 ± 195	21365 ± 54	26.91 ± 11.04	98862 ± 204	40.4 ± 4.3	48.70	0.127	94.3	5.7	9.20 ± 0.07	30.48 ± 0.26	y		
3.18W	204825 ± 186	21191 ± 45	6.13 ± 11.66	115269 ± 218	42.3 ± 3.4	48.71	0.108	93.9	5.7	9.08 ± 0.05	30.06 ± 0.23	n		
3.63W	161338 ± 281	16789 ± 39	19.75 ± 9.40	107881 ± 184	35.5 ± 6.6	48.74	0.092	93.5	4.5	8.99 ± 0.12	29.76 ± 0.42	n		
4.29W	135614 ± 198	14135 ± 34	22.44 ± 9.37	104125 ± 142	48.9 ± 6.3	48.75	0.080	89.4	3.8	8.57 ± 0.13	28.41 ± 0.46	n		
5.07W	87771 ± 176	8931 ± 26	20.62 ± 6.96	77938 ± 144	45.3 ± 6.9	48.77	0.067	84.7	2.4	8.33 ± 0.23	27.60 ± 0.77	n		
Plateau Age(1.89W) -(2.805W)												30.87 ± 0.10		
sample ID	A2-604	Analysis ID:	U21008	Irradiation ID:	KUR2002									
J=	0.0018565													
1.44W	375632 ± 907	9082 ± 38	113.01 ± 5.41	20251.1 ± 102.6	481.8 ± 7.6	48.79	0.264	62.1	2.5	25.69 ± 0.29	84.04 ± 1.01	n		
1.515W	282368 ± 819	9729 ± 37	90.90 ± 8.75	25487.3 ± 172.3	293.9 ± 9.4	48.82	0.225	69.2	2.7	20.10 ± 0.31	66.08 ± 1.04	n		
1.65W	310500 ± 992	14253 ± 51	63.49 ± 13.12	44347.2 ± 163.0	258.0 ± 5.0	48.84	0.189	75.4	3.9	16.43 ± 0.14	54.22 ± 0.52	n		
1.8W	333346 ± 1213	19810 ± 82	68.43 ± 10.08	71803 ± 251	223.13 ± 4.77	48.85	0.162	80.2	5.4	13.50 ± 0.11	44.65 ± 0.42	n		
1.965W	338991 ± 956	24183 ± 78	49.67 ± 4.87	96179 ± 367	171.82 ± 4.56	48.87	0.148	85.0	6.6	11.92 ± 0.08	39.48 ± 0.32	n		
2.145W	341177 ± 1013	27677 ± 86	35.92 ± 12.08	114540 ± 395	120.24 ± 7.21	48.89	0.142	89.6	7.6	11.04 ± 0.09	36.61 ± 0.35	n		
2.34W	334974 ± 1081	30077 ± 102	30.74 ± 12.05	127970 ± 452	81.7 ± 6.7	48.91	0.138	92.8	8.2	10.33 ± 0.08	34.29 ± 0.32	n		
2.45W	340257 ± 1118	33106 ± 110	7.49 ± 11.67	134460 ± 53.2	67.3 ± 4.8	48.92	0.136	92.8	8.0	9.87 ± 0.06	33.79 ± 0.25	n		
2.79W	361520 ± 1007	36445 ± 117	-21.25 ± 8.34	151935 ± 774	46.63 ± 6.65	48.94	0.141	96.2	9.9	9.54 ± 0.07	31.68 ± 0.27	y		
3.03W	322725 ± 796	33290 ± 130	-8.48 ± 8.89	128601 ± 507	36.50 ± 4.75	48.96	0.152	96.7	9.1	9.37 ± 0.06	31.11 ± 0.25	y		
3.3W	275417 ± 691	28553 ± 73	-1.94 ± 14.01	103294 ± 422	24.64 ± 7.63	48.98	0.163	97.4	7.8	9.39 ± 0.09	31.18 ± 0.32	y		
3.6W	215260 ± 604	22443 ± 87	12.03 ± 8.48	79596 ± 248	27.1 ± 4.7	48.99	0.166	96.3	6.1	9.23 ± 0.08	30.66 ± 0.29	y		
4.02W	192948 ± 153	19971 ± 24	9.45 ± 6.85	73866 ± 151	31.6 ± 6.3	49.54	0.159	95.2	5.4	9.19 ± 0.09	30.53 ± 0.35	y		
4.62W	184471 ± 236	18699 ± 27	-2.45 ± 7.32	75739 ± 145	41.05 ± 5.31	49.56	0.145	93.4	5.1	9.22 ± 0.09	30.61 ± 0.32	y		
5.4W	190653 ± 245	19336 ± 26	11.28 ± 8.54	86607 ± 111	51.92 ± 5.47	49.57	0.131	92.0	5.3	9.07 ± 0.09	30.11 ± 0.32	n		
6.42W	197046 ± 292	19876 ± 60	25.46 ± 9.38	117786 ± 145	66.29 ± 5.21	49.60	0.099	90.1	5.4	8.93 ± 0.08	29.66 ± 0.31	n		
Plateau Age(2.79W) -(4.62W)												31.02 ± 0.12		
sample ID	A1-61	Analysis ID:	U21009	Irradiation ID:	KUR2002									
J=	0.0018625													
1.44W	490132 ± 1659	53359 ± 204	103.18 ± 11.11	36462.5 ± 105.5	85.5 ± 4.1	49.63	0.861	94.8	10.6	8.71 ± 0.05	29.04 ± 0.22	n		
1.515W	399325 ± 1211	44227 ± 159	81.48 ± 12.35	39445.7 ± 109.8	44.2 ± 6.2	49.66	0.860	96.7	8.8	8.73 ± 0.06	29.11 ± 0.24	y		
1.605W	359764 ± 800	39922 ± 90	52.09 ± 12.50	49000.8 ± 211.7	22.8 ± 3.9	49.67	0.479	98.1	7.9	8.84 ± 0.04	29.47 ± 0.20	y		
1.71W	352347 ± 817	38882 ± 115	56.18 ± 17.46	67165 ± 253	22.70 ± 5.22	49.69	0.341	98.1	7.7	8.89 ± 0.05	29.63 ± 0.23	y		
1.83W	333127 ± 848	36852 ± 102	49.45 ± 10.98	86557 ± 348	18.51 ± 5.11	49.70	0.250	98.4	7.3	8.89 ± 0.05	29.63 ± 0.23	y		
1.98W	358317 ± 1050	39585 ± 121	11.86 ± 12.92	123850 ± 671	23.86 ± 4.99	49.73	0.188	98.0	7.8	8.87 ± 0.05	29.57 ± 0.23	y		
2.16W	356769 ± 996	39508 ± 118	14.13 ± 15.49	154588 ± 529	9.8 ± 4.8	49.74	0.150	99.2	7.8	8.96 ± 0.05	29.85 ± 0.22	y		
2.355W	343419 ± 1319	37910 ± 134	15.50 ± 9.19	174908 ± 753	11.3 ± 6.8	49.76	0.127	99.0	7.5	8.97 ± 0.07	29.89 ± 0.27	y		
2.565W	303991 ± 758	33597 ± 97	-18.20 ± 10.45	14546 ± 902	6.49 ± 5.46	49.77	0.115	99.4	6.6	8.99 ± 0.06	29.96 ± 0.25	y		
2.79W	264319 ± 882	29039 ± 91	-3.80 ± 9.89	162324 ± 771	15.89 ± 7.65	49.80	0.105	98.2	5.7	8.94 ± 0.09	29.86 ± 0.32	y		
3.03W	203703 ± 511	22378 ± 69	-9.66 ± 11.88	131690 ± 534	10.04 ± 3.73	49.81	0.100	98.5	4.4	8.97 ± 0.06	29.89 ± 0.25	y		
3.33W	164953 ± 427	18098 ± 57	-1.13 ± 10.56	106690 ± 362	2.5 ± 5.5	49.83	0.100	99.6	3.6	9.07 ± 0.10	30.24 ± 0.36	y		
3.75W	157341 ± 501	17246 ± 76	5.93 ± 10.72	93558 ± 388	22.0 ± 4.9	49.85	0.108	95.9	3.4	8.75 ± 0.10	29.15 ± 0.35	y		
4.38W	191430 ± 728	20791 ± 83	20.99 ± 7.04	89093 ± 408	33.33 ± 4.60	49.87	0.137	94.9	4.1	8.73 ± 0.08	29.11 ± 0.31	y		
5.25W	182532 ± 641	19654 ± 87	25.46 ± 10.68	86084 ± 409	47.25 ± 2.97	49.89	0.134	92.4	3.9	8.58 ± 0.07	28.59 ± 0.26	n		
6.6W	96723 ± 287	10339 ± 32	31.38 ± 5.34	83498 ± 300	35.35 ± 6.72	49.90	0.073	89.2	2.0	8.34 ± 0.20	27.82 ± 0.66	n		
8.25W	36861 ± 150	3910 ± 28	2.75 ± 4.48	74486 ± 285	15.44 ± 3.08	49.92	0.031	87.6	0.8	8.26 ± 0.24	27.54 ± 0.81	n		
Plateau Age(1.515W) -(4.38W)												29.63 ± 0.07		
sample ID	A2-162	Analysis ID:	U19241	Irradiation ID:	KUR1804									
J=	0.0018429													
1.44W	286630 ± 1392	17972 ± 111	117.36 ± 11.71	25730 ± 605	354.0 ± 9.4	223.89	0.452	63.5	6.9	9.20 ± 0.17	30.32 ± 0.56	y		
1.53W	239469 ± 663	17943 ± 72	84.85 ± 11.37	33064 ± 1013	243.5 ± 9.5	223.92	0.319	70.0	6.3	9.34 ± 0.17	30.78 ± 0.56	y		
1.68W	244380 ± 448	19662 ± 73	85.43 ± 8.94	53444 ± 954	224.4 ± 7.7	224.47	0.216	72.9	6.9	9.06 ± 0.12	29.86 ± 0.43	y		
1.86W	291723 ± 618	25357 ± 73	36.52 ± 12.97	92909 ± 2163	189.6 ± 6.0	224.49	0.161	80.8	8.8	9.29 ± 0.08	30.64 ± 0.30	y		
2.04W	314048 ± 1466	29139 ± 161	35.79 ± 15.57	132645 ± 743	153.6 ± 5.4	224.51	0.129	85.5	10.2	9.22 ± 0.09	30.40 ± 0.33	y		
2.22W	314484 ± 803	30684 ± 111	48.19 ± 14.60	161574 ± 1924	116.2 ± 7.2	224.54	0.112	89.1	10.7	9.13 ± 0.08	30.10 ± 0.30	y		
2.4W	302339 ± 745	30357 ± 114	32.67 ± 15.49	179526 ± 2481	96.8 ± 6.4	224.56	0.099	90.5	10.6	9.02 ± 0.08	29.73 ± 0.29	y		
2.58W	244081 ± 588	25176 ± 86	9.01 ± 16.886	8213 ± 61.2	66.1 ± 8.8	224.57	0.090	82.0	8.8	8.98 ± 0.09	29.61 ± 0.32	y		
2.76W	197606 ± 440	20081 ± 56	15.89 ± 8.19	141079 ± 1213	55.7 ± 3.4	224.59	0.084	91.7	7.0	9.02 ± 0.06	29.75 ± 0.25	y		
2.97W	156531 ± 173	17284 ± 45	14.26 ± 8.89	127411 ± 1281	34.5 ± 7.7	224.63	0.080	93.8	6.0	8.99 ± 0.13	29.65 ± 0.46	y		
3.24W	138517 ± 226	14570 ± 48	20.77 ± 15.10	120038 ± 1729	32.2 ± 4.1	224.65	0.071	93.1	5.1	8.85 ± 0.09	29.20 ± 0.33	n		
3.57W	115906 ± 221	12280 ± 35	12.71 ± 8.10	106690 ± 1823	24.5 ± 4.0	224.67	0.068	93.8	4.3	8.85 ± 0.10	29.19 ± 0.36	n		
3.96W	94503 ± 223	10152 ± 48	5.61 ± 9.17	97201 ± 1440	26.9 ± 6.4	224.68	0.061	91.6	3.5	8.52 ± 0.19	28.12 ± 0.64	n		
4.41W	71412 ± 125	7662 ± 20	-4.01 ± 6.65	80130 ± 1362	32.4 ± 6.3	224.72	0.056	86.6	2.7	8.07 ± 0.24	26.64 ± 0.81	n		
5.1W	61246 ± 91	6850 ± 23	17.41 ± 10.49	100288 ± 1036	34.6 ± 3.7	224.85	0.040	83.3	2.4	7.45 ± 0.16	24.59 ± 0.55	n		
Plateau Age(1.44W) -(2.97W)												30.02 ± 0.11		
Interference correction factors														
(39/37)Ca	0.000677 ± 0.000005													
(36/37)Ca	0.000257 ± 0.000004													
(40/39)K	0.004995 ± 0.000210													
(38/39)K	0.011342 ± 0.000132													

Table S3. Recalibrated $^{40}\text{Ar}/^{39}\text{Ar}$ ages of this study and previous studies for the Lima Limo section, Ethiopia.

Sample ID, original sample name therein from the literature. Pol., geomagnetic polarity determined in the original literature; $^{40}\text{Ar}/^{39}\text{Ar}$ (recalibrated), recalibrated $^{40}\text{Ar}/^{39}\text{Ar}$ age estimate (in Ma) using the updated ^{40}K decay constant (Min et al. 2000) and FCs standard with an age of Kuiper et al. (2008), with its 2σ uncertainty; Std, standard originally used as the neutron fluence monitors for $^{40}\text{Ar}/^{39}\text{Ar}$ dating; Ref, reference of age data. Blank means "no data" or "no applicable". We recalibrated $^{40}\text{Ar}/^{39}\text{Ar}$ ages of A1-61 and A2-162 in this study, while Ahn et al. (2021) recalibrated the others.

Locality	Sample ID	Altitude (m)	Rock type	Pol.	$^{40}\text{Ar}/^{39}\text{Ar}$ plateau (recalibrated)			$^{40}\text{Ar}/^{39}\text{Ar}$ plateau (original)			Ref
					Age (Ma)	2σ (Ma)		Age (Ma)	2σ (Ma)	Std	
Lima-Limo	LLC	3220	silicic	R	29.9	± 0.10		29.7	± 0.10	Hb3gr (1072 Ma)	Rochette et al. (1998)
Lima-Limo	A1-61	3190	basaltic	R	29.82	± 0.14		29.6	± 0.14	FC3 (27.5 Ma)	This study
Lima-Limo	PM26	3060	basaltic	R	29.7	± 2.2		29.4	± 2.2	Hb3gr (1072 Ma)	Hofmann et al. (1997)
Lima-Limo	PM29	2980	basaltic	R	30.3	± 0.2		30.0	± 0.2	Hb3gr (1072 Ma)	Hofmann et al. (1997)
Lima-Limo	E100	2810	basaltic	R	29.9	± 0.6		29.6	± 0.6	Hb3gr (1072 Ma)	Hofmann et al. (1997)
Lima-Limo	98EH163	2660	silicic		30.27	± 0.60		29.84	± 0.60	HD-B1 (24.2 Ma)	Coulié et al. (2003)
Lima-Limo	A2-162	2603	basaltic	R	30.21	± 0.22		30.02	± 0.22	FC3 (27.5 Ma)	This study
Lima-Limo	PM6	2500	basaltic	R	30.3	± 0.6		30.0	± 0.6	Hb3gr (1072 Ma)	Hofmann et al. (1997)
Lima-Limo	98EH150	2460	silicic		30.05	± 0.60		29.62	± 0.60	HD-B1 (24.2 Ma)	Coulié et al. (2003)
Lima-Limo	E98	2440	basaltic	R	28.9	± 0.6		28.6	± 0.6	Hb3gr (1072 Ma)	Hofmann et al. (1997)
Lima-Limo	VC97-02	2350	silicic		30.24	± 0.60		29.81	± 0.60	HD-B1 (24.2 Ma)	Coulié et al. (2003)
Lima-Limo	VC97-01	2280	silicic		30.19	± 0.60		29.76	± 0.60	HD-B1 (24.2 Ma)	Coulié et al. (2003)
Lima-Limo	LLB	2250	silicic	N	30.4	± 0.2		30.1	± 0.2	Hb3gr (1072 Ma)	Rochette et al. (1998)
Lima-Limo	LLA	2120	silicic	N	30.4	± 0.2		30.1	± 0.2	Hb3gr (1072 Ma)	Rochette et al. (1998)
Adi Arkay	E86	1730	basaltic		30.9	± 2.0		30.5	± 2.0	Hb3gr (1072 Ma)	Hofmann et al. (1997)
Adi Arkay	E203	1700	basaltic		30.8	± 0.8		30.4	± 0.8	Hb3gr (1072 Ma)	Hofmann et al. (1997)
Lima-Limo	E199	1400	basaltic	R	31.5	± 1.2		31.1	± 1.2	Hb3gr (1072 Ma)	Hofmann et al. (1997)
May Tsemre	E84	1320	basaltic		31.2	± 0.8		30.8	± 0.8	Hb3gr (1072 Ma)	Hofmann et al. (1997)

Table S3. Results of eruption age models calculation using model bacon

All ages				Selected ages (our and Rochette)			
Altitude (m)	Average (Ma)	95% confidence interval		Altitude (m)	Average (Ma)	95% confidence interval	
		Minimum (Ma)	Maximum (Ma)			Minimum (Ma)	Maximum (Ma)
3220	29.896653	29.73542	30.05404	3220	29.874078	29.701502	30.041698
3219	29.897177	29.736159	30.054436	3219	29.874568	29.702393	30.042392
3218	29.8977	29.737027	30.054687	3218	29.875059	29.702943	30.042684
3217	29.898224	29.738155	30.055027	3217	29.875549	29.703476	30.042936
3216	29.898747	29.738779	30.055859	3216	29.876004	29.704634	30.043284
3215	29.899271	29.739338	30.056571	3215	29.87653	29.705569	30.043749
3214	29.899795	29.740226	30.057451	3214	29.877021	29.706377	30.044147
3213	29.900318	29.740917	30.057741	3213	29.877511	29.706925	30.044654
3212	29.900842	29.741253	30.058388	3212	29.878002	29.707343	30.044807
3211	29.901365	29.741913	30.058711	3211	29.878492	29.707915	30.045641
3210	29.901889	29.742505	30.059194	3210	29.878983	29.708203	30.046136
3209	29.902413	29.743058	30.059603	3209	29.879473	29.708612	30.046586
3208	29.902936	29.743564	30.060091	3208	29.879964	29.709014	30.047539
3207	29.90346	29.744247	30.060227	3207	29.880454	29.709643	30.048542
3206	29.903983	29.745017	30.060634	3206	29.880945	29.71041	30.048962
3205	29.904507	29.746236	30.060862	3205	29.881436	29.711045	30.049187
3204	29.905031	29.746959	30.061276	3204	29.881926	29.711303	30.049635
3203	29.905554	29.747578	30.061546	3203	29.882417	29.711641	30.050239
3202	29.906078	29.7482	30.062043	3202	29.882907	29.712161	30.050751
3201	29.906601	29.748856	30.062571	3201	29.883398	29.712693	30.051236
3200	29.907125	29.749458	30.062995	3200	29.883888	29.71347	30.052267
3199	29.907649	29.750019	30.063413	3199	29.884379	29.714216	30.052776
3198	29.908172	29.750688	30.063774	3198	29.884869	29.715117	30.053327
3197	29.908696	29.751295	30.064089	3197	29.88536	29.715559	30.053699
3196	29.909219	29.751705	30.064526	3196	29.88585	29.716134	30.05392
3195	29.909743	29.752447	30.065246	3195	29.886341	29.716753	30.054454
3194	29.910267	29.752882	30.065722	3194	29.886831	29.717228	30.054792
3193	29.91079	29.753554	30.066223	3193	29.887322	29.717848	30.055141
3192	29.911314	29.75401	30.066589	3192	29.887812	29.718457	30.055476
3191	29.911837	29.754809	30.067116	3191	29.888303	29.718818	30.055815
3190	29.912361	29.755496	30.067671	3190	29.888793	29.719483	30.056254
3189	29.912885	29.755884	30.068455	3189	29.889284	29.719916	30.056837
3188	29.913408	29.756701	30.06921	3188	29.889775	29.720418	30.057421
3187	29.913932	29.757148	30.069767	3187	29.890265	29.721047	30.05783
3186	29.914455	29.757316	30.070035	3186	29.890756	29.721274	30.058476
3185	29.914979	29.757939	30.070489	3185	29.891246	29.72163	30.058885
3184	29.915503	29.758508	30.070907	3184	29.891737	29.721829	30.059689
3183	29.916026	29.758916	30.07145	3183	29.892227	29.722205	30.060202
3182	29.91655	29.759099	30.071784	3182	29.892718	29.722515	30.060818
3181	29.917073	29.759588	30.072192	3181	29.893208	29.723075	30.061022
3180	29.917597	29.759909	30.072609	3180	29.893699	29.723086	30.061555
3179	29.918121	29.760419	30.07307	3179	29.894189	29.723437	30.062022
3178	29.918644	29.760969	30.073555	3178	29.89468	29.723828	30.062618
3177	29.919168	29.761455	30.07444	3177	29.89517	29.724243	30.063157
3176	29.919691	29.762661	30.07513	3176	29.895661	29.724662	30.063754
3175	29.920215	29.763489	30.075677	3175	29.896151	29.725438	30.064143
3174	29.920739	29.764053	30.075919	3174	29.896642	29.726478	30.0644
3173	29.921262	29.764439	30.07616	3173	29.897132	29.727443	30.064813
3172	29.921786	29.765141	30.076767	3172	29.897623	29.728408	30.065456
3171	29.922309	29.76597	30.077157	3171	29.898114	29.729401	30.066351
3170	29.922833	29.766855	30.077884	3170	29.898604	29.729993	30.066902
3169	29.923357	29.76712	30.078331	3169	29.899095	29.730474	30.067296
3168	29.92388	29.767452	30.078739	3168	29.899585	29.731118	30.067716
3167	29.924404	29.768065	30.079338	3167	29.900076	29.731402	30.068042
3166	29.924927	29.76864	30.079858	3166	29.900566	29.731765	30.068496
3165	29.925451	29.769028	30.080639	3165	29.901057	29.732224	30.068886
3164	29.925975	29.769441	30.08117	3164	29.901547	29.732575	30.069443
3163	29.926498	29.770006	30.081779	3163	29.902038	29.733498	30.069855
3162	29.927022	29.770684	30.082261	3162	29.902528	29.734403	30.070519
3161	29.927545	29.771122	30.082909	3161	29.903019	29.734635	30.070835
3160	29.928069	29.771982	30.083884	3160	29.903509	29.735023	30.071525
3159	29.928593	29.772336	30.084124	3159	29.904	29.73541	30.072207
3158	29.929116	29.772668	30.084711	3158	29.90449	29.735798	30.073283
3157	29.92964	29.772988	30.08564	3157	29.904981	29.736095	30.073575
3156	29.930163	29.773415	30.086127	3156	29.905471	29.736519	30.074369
3155	29.930687	29.773996	30.086622	3155	29.905962	29.736768	30.074949
3154	29.931211	29.774388	30.087504	3154	29.906453	29.737016	30.075635
3153	29.931734	29.774825	30.088135	3153	29.906943	29.737264	30.076041
3152	29.932258	29.775164	30.088921	3152	29.907434	29.73751	30.076507
3151	29.932781	29.775832	30.089354	3151	29.907924	29.73771	30.077039
3150	29.933305	29.776196	30.090047	3150	29.908415	29.738075	30.077774
3149	29.933829	29.776808	30.090577	3149	29.908905	29.738624	30.078107
3148	29.934352	29.777706	30.091045	3148	29.909396	29.738987	30.07972
3147	29.934876	29.777545	30.09161	3147	29.909886	29.739171	30.080424
3146	29.935399	29.777694	30.092049	3146	29.910377	29.739493	30.081114
3145	29.935923	29.777947	30.092722	3145	29.910867	29.739801	30.08179

3144	29.936447	29.778119	30.093448	3144	29.911358	29.740079	30.08227
3143	29.93697	29.778345	30.094066	3143	29.911848	29.740365	30.082991
3142	29.937494	29.778563	30.094905	3142	29.912339	29.740657	30.084281
3141	29.938017	29.779053	30.095306	3141	29.912829	29.741015	30.084921
3140	29.938541	29.779533	30.095963	3140	29.91332	29.741578	30.085785
3139	29.939065	29.779684	30.096749	3139	29.913811	29.742079	30.08649
3138	29.939588	29.779933	30.097563	3138	29.914301	29.742342	30.086773
3137	29.940112	29.780391	30.098094	3137	29.914792	29.742557	30.087436
3136	29.940636	29.780916	30.09876	3136	29.915282	29.742771	30.087971
3135	29.941159	29.781304	30.099465	3135	29.915773	29.743393	30.089233
3134	29.941683	29.781837	30.100102	3134	29.916263	29.7436	30.089837
3133	29.942206	29.782177	30.100615	3133	29.916754	29.744245	30.090097
3132	29.94273	29.782392	30.101421	3132	29.917244	29.744772	30.09125
3131	29.943254	29.782945	30.102101	3131	29.917735	29.744832	30.091818
3130	29.943777	29.783159	30.10274	3130	29.918225	29.745461	30.092791
3129	29.944301	29.783331	30.103302	3129	29.918716	29.745477	30.093126
3128	29.944824	29.783676	30.103863	3128	29.919206	29.745493	30.093465
3127	29.945348	29.783851	30.104447	3127	29.919697	29.745509	30.094539
3126	29.945872	29.784068	30.105105	3126	29.920187	29.745979	30.095647
3125	29.946395	29.784698	30.106014	3125	29.920678	29.746528	30.096051
3124	29.946919	29.785098	30.106827	3124	29.921168	29.747078	30.096516
3123	29.947442	29.78555	30.107613	3123	29.921659	29.747705	30.097493
3122	29.947966	29.785989	30.108156	3122	29.92215	29.748154	30.098552
3121	29.94849	29.786242	30.109135	3121	29.92264	29.748695	30.099657
3120	29.949013	29.786568	30.109894	3120	29.923131	29.748925	30.10022
3119	29.949537	29.786754	30.110983	3119	29.923621	29.749111	30.100852
3118	29.95006	29.787174	30.111553	3118	29.924112	29.749296	30.101594
3117	29.950584	29.7876	30.112957	3117	29.924602	29.749482	30.103015
3116	29.951108	29.787863	30.113743	3116	29.925093	29.749667	30.103764
3115	29.951631	29.788265	30.114602	3115	29.925583	29.749853	30.104535
3114	29.952155	29.788567	30.115543	3114	29.926074	29.750236	30.105
3113	29.952678	29.788909	30.11657	3113	29.926564	29.750644	30.105592
3112	29.953202	29.789257	30.117117	3112	29.927055	29.750959	30.106245
3111	29.953726	29.789676	30.118338	3111	29.927545	29.751223	30.106865
3110	29.954249	29.789887	30.118688	3110	29.928036	29.751724	30.108091
3109	29.954773	29.790148	30.119018	3109	29.928526	29.752294	30.108734
3108	29.955296	29.790317	30.120027	3108	29.929017	29.752712	30.109367
3107	29.95582	29.790504	30.121161	3107	29.929507	29.753125	30.110304
3106	29.956344	29.790708	30.121963	3106	29.929998	29.753766	30.111282
3105	29.956867	29.791023	30.123029	3105	29.930489	29.754161	30.112034
3104	29.957391	29.791395	30.124116	3104	29.930979	29.754828	30.112342
3103	29.957914	29.791587	30.125657	3103	29.93147	29.75539	30.11308
3102	29.958438	29.791866	30.126686	3102	29.93196	29.755701	30.113871
3101	29.958962	29.79228	30.127407	3101	29.932451	29.756633	30.114669
3100	29.959485	29.792441	30.128296	3100	29.932941	29.756727	30.115012
3099	29.960009	29.79292	30.129493	3099	29.933432	29.756927	30.115417
3098	29.960532	29.793305	30.129933	3098	29.933922	29.75766	30.116571
3097	29.961056	29.793468	30.130223	3097	29.934413	29.757958	30.117899
3096	29.96158	29.793673	30.130861	3096	29.934903	29.758032	30.118701
3095	29.962103	29.794099	30.132482	3095	29.935394	29.75813	30.119498
3094	29.962617	29.794696	30.13297	3094	29.935886	29.758965	30.119966
3093	29.96313	29.795649	30.133404	3093	29.936379	29.759478	30.120677
3092	29.963644	29.796945	30.133885	3092	29.936871	29.760163	30.121117
3091	29.964157	29.797807	30.134499	3091	29.937364	29.760834	30.121407
3090	29.964671	29.798308	30.135191	3090	29.937856	29.761074	30.121698
3089	29.965184	29.798893	30.135708	3089	29.938349	29.761706	30.121897
3088	29.965698	29.799413	30.135999	3088	29.938841	29.762496	30.122852
3087	29.966212	29.800159	30.136648	3087	29.939334	29.762667	30.123129
3086	29.966725	29.800878	30.136826	3086	29.939826	29.763085	30.123406
3085	29.967239	29.8015	30.137254	3085	29.940319	29.763974	30.123688
3084	29.967752	29.802179	30.137575	3084	29.940812	29.764837	30.123972
3083	29.968266	29.802588	30.138103	3083	29.941304	29.765251	30.124246
3082	29.968779	29.803597	30.138509	3082	29.941797	29.765905	30.124747
3081	29.969293	29.804161	30.138992	3081	29.942289	29.766192	30.125599
3080	29.969806	29.804402	30.13948	3080	29.942782	29.766438	30.126164
3079	29.97032	29.805186	30.139653	3079	29.943274	29.767065	30.126472
3078	29.970834	29.806005	30.140059	3078	29.943767	29.767419	30.127302
3077	29.971347	29.806551	30.140506	3077	29.944259	29.768294	30.127866
3076	29.971861	29.806946	30.140922	3076	29.944752	29.768586	30.128434
3075	29.972374	29.807482	30.141377	3075	29.945244	29.768665	30.128998
3074	29.972888	29.808175	30.141856	3074	29.945737	29.76939	30.129139
3073	29.973401	29.808882	30.142299	3073	29.946229	29.769686	30.129373
3072	29.973915	29.809626	30.142645	3072	29.946722	29.770673	30.129663
3071	29.974428	29.810203	30.142994	3071	29.947214	29.771259	30.130315
3070	29.974942	29.810851	30.143517	3070	29.947707	29.771988	30.131077
3069	29.975456	29.811434	30.144023	3069	29.948199	29.772768	30.13121
3068	29.975969	29.812256	30.144459	3068	29.948692	29.773208	30.131713
3067	29.976483	29.812936	30.144686	3067	29.949184	29.773593	30.132056
3066	29.976996	29.813349	30.145365	3066	29.949677	29.774274	30.132826

3065	29.97751	29.813683	30.145695	3065	29.950169	29.774534	30.133602
3064	29.978023	29.813866	30.146019	3064	29.950662	29.774769	30.134193
3063	29.978537	29.814121	30.146132	3063	29.951154	29.775182	30.134496
3062	29.97905	29.814562	30.146251	3062	29.951647	29.775886	30.134839
3061	29.979564	29.815428	30.146441	3061	29.952139	29.776442	30.135444
3060	29.980077	29.815731	30.146918	3060	29.952632	29.776893	30.135836
3059	29.980591	29.816267	30.147005	3059	29.953124	29.777533	30.13623
3058	29.981105	29.817244	30.14735	3058	29.953617	29.777782	30.136591
3057	29.981618	29.817569	30.147496	3057	29.95411	29.778517	30.137018
3056	29.982132	29.818294	30.14809	3056	29.954602	29.778987	30.137236
3055	29.982645	29.81877	30.148667	3055	29.955095	29.779457	30.137806
3054	29.983159	29.819594	30.148985	3054	29.955587	29.779926	30.13821
3053	29.983672	29.820228	30.149471	3053	29.95608	29.780391	30.13858
3052	29.984186	29.820779	30.149811	3052	29.956572	29.780616	30.13878
3051	29.984699	29.82172	30.150337	3051	29.957065	29.781182	30.138994
3050	29.985213	29.82268	30.150585	3050	29.957557	29.781799	30.139325
3049	29.985727	29.823472	30.151206	3049	29.95805	29.782272	30.139829
3048	29.98624	29.823914	30.151695	3048	29.958542	29.782739	30.140575
3047	29.986754	29.824179	30.151948	3047	29.959035	29.783114	30.141437
3046	29.987267	29.824934	30.152498	3046	29.959527	29.78326	30.142288
3045	29.987781	29.825396	30.153013	3045	29.96002	29.784104	30.143131
3044	29.988294	29.825749	30.153825	3044	29.960512	29.784536	30.143296
3043	29.988808	29.825991	30.154431	3043	29.961005	29.785089	30.143958
3042	29.989321	29.826557	30.15495	3042	29.961497	29.785567	30.144494
3041	29.989835	29.826995	30.155429	3041	29.96199	29.786033	30.144985
3040	29.990349	29.827341	30.156155	3040	29.962482	29.786503	30.145752
3039	29.990862	29.827798	30.156838	3039	29.962975	29.786974	30.146233
3038	29.991376	29.828236	30.157745	3038	29.963467	29.787543	30.146758
3037	29.991889	29.828843	30.158603	3037	29.96396	29.788097	30.147939
3036	29.992403	29.82977	30.1593	3036	29.964452	29.788552	30.148569
3035	29.992916	29.8305	30.159549	3035	29.964945	29.788974	30.148903
3034	29.99343	29.830923	30.160254	3034	29.965437	29.789689	30.149463
3033	29.993943	29.831537	30.160922	3033	29.96593	29.790397	30.149795
3032	29.994457	29.832063	30.161464	3032	29.966423	29.790955	30.150785
3031	29.994971	29.832431	30.162127	3031	29.966915	29.79156	30.15203
3030	29.995484	29.833035	30.162794	3030	29.967408	29.791923	30.152453
3029	29.995998	29.833387	30.16356	3029	29.9679	29.792281	30.153205
3028	29.996511	29.833702	30.164241	3028	29.968393	29.79264	30.153827
3027	29.997025	29.834121	30.164662	3027	29.968885	29.792998	30.154251
3026	29.997538	29.834471	30.164933	3026	29.969378	29.793502	30.155062
3025	29.998052	29.834656	30.1657	3025	29.96987	29.793945	30.155899
3024	29.998565	29.835305	30.166201	3024	29.970363	29.794617	30.156285
3023	29.999079	29.835733	30.166948	3023	29.970855	29.795258	30.156701
3022	29.999592	29.836066	30.16724	3022	29.971348	29.795501	30.156893
3021	30.000106	29.836315	30.167684	3021	29.97184	29.795739	30.157602
3020	30.00062	29.836683	30.168044	3020	29.972333	29.795976	30.157957
3019	30.001133	29.83713	30.16872	3019	29.972825	29.796377	30.158522
3018	30.001647	29.837696	30.169046	3018	29.973318	29.796599	30.158993
3017	30.00216	29.838103	30.16985	3017	29.97381	29.796709	30.16002
3016	30.002674	29.838581	30.170547	3016	29.974303	29.797117	30.160732
3015	30.003187	29.839078	30.171254	3015	29.974795	29.797596	30.161544
3014	30.003701	29.839451	30.171417	3014	29.975288	29.798054	30.161764
3013	30.004214	29.839587	30.17207	3013	29.97578	29.798539	30.162732
3012	30.004728	29.839836	30.172606	3012	29.976273	29.798901	30.163334
3011	30.005242	29.839935	30.173751	3011	29.976765	29.79915	30.163727
3010	30.005755	29.84052	30.17446	3010	29.977258	29.799464	30.164071
3009	30.006269	29.841089	30.17476	3009	29.97775	29.800034	30.165057
3008	30.006782	29.841685	30.175272	3008	29.978243	29.80033	30.165275
3007	30.007296	29.842191	30.175566	3007	29.978735	29.800747	30.165722
3006	30.007809	29.842586	30.176213	3006	29.979228	29.801154	30.166442
3005	30.008323	29.842975	30.176927	3005	29.979721	29.801255	30.167113
3004	30.008836	29.843212	30.177714	3004	29.980213	29.801429	30.167987
3003	30.00935	29.843391	30.178622	3003	29.980706	29.801731	30.168637
3002	30.009864	29.843689	30.179661	3002	29.981198	29.802145	30.169344
3001	30.010377	29.843812	30.180531	3001	29.981691	29.802574	30.170182
3000	30.010891	29.844076	30.181192	3000	29.982183	29.802993	30.170701
2999	30.011404	29.844451	30.18221	2999	29.982676	29.803406	30.171262
2998	30.011918	29.844825	30.18312	2998	29.983168	29.803657	30.172052
2997	30.012431	29.845397	30.183856	2997	29.983661	29.803819	30.172725
2996	30.012945	29.845806	30.184851	2996	29.984153	29.804213	30.173238
2995	30.013458	29.845973	30.185725	2995	29.984646	29.804718	30.174011
2994	30.013972	29.846161	30.186232	2994	29.985138	29.804988	30.174538
2993	30.014485	29.846633	30.187019	2993	29.985631	29.805232	30.174974
2992	30.014999	29.84704	30.188409	2992	29.986123	29.805533	30.175635
2991	30.015513	29.84726	30.189209	2991	29.986616	29.805718	30.176764
2990	30.016026	29.847443	30.189966	2990	29.987108	29.805972	30.177462
2989	30.01654	29.847799	30.190485	2989	29.987601	29.806223	30.1781
2988	30.017053	29.848073	30.191473	2988	29.988093	29.806469	30.178562
2987	30.017567	29.848472	30.19204	2987	29.988586	29.8067	30.17931

2986	30.01808	29.848588	30.192802	2986	29.989078	29.8071	30.179657
2985	30.018594	29.848815	30.194166	2985	29.989571	29.807693	30.180361
2984	30.019107	29.848954	30.194549	2984	29.990063	29.808187	30.181329
2983	30.019621	29.849162	30.194976	2983	29.990556	29.808459	30.181962
2982	30.020135	29.849466	30.195674	2982	29.991048	29.809029	30.182521
2981	30.020648	29.849698	30.196441	2981	29.991541	29.809923	30.183195
2980	30.021162	29.850022	30.19722	2980	29.992033	29.809916	30.183599
2979	30.021675	29.850295	30.198106	2979	29.992526	29.810281	30.184474
2978	30.022189	29.850565	30.198697	2978	29.993019	29.810639	30.18525
2977	30.022702	29.8511	30.19955	2977	29.993511	29.810895	30.186283
2976	30.023216	29.851288	30.200798	2976	29.994004	29.811246	30.187157
2975	30.023729	29.851373	30.201666	2975	29.994496	29.811639	30.188215
2974	30.024243	29.85172	30.202337	2974	29.994989	29.811976	30.189032
2973	30.024757	29.851909	30.202952	2973	29.995481	29.812379	30.189702
2972	30.02527	29.852195	30.203521	2972	29.995974	29.812799	30.190486
2971	30.025784	29.852457	30.204376	2971	29.996466	29.813062	30.192095
2970	30.026297	29.852763	30.205554	2970	29.996959	29.813217	30.193035
2969	30.026743	29.853682	30.205898	2969	29.997451	29.813862	30.193604
2968	30.027188	29.854526	30.206428	2968	29.997944	29.814857	30.194028
2967	30.027634	29.855286	30.206698	2967	29.998437	29.815613	30.194188
2966	30.028079	29.855773	30.206975	2966	29.99893	29.816158	30.194416
2965	30.028525	29.856357	30.207307	2965	29.999423	29.816487	30.194649
2964	30.02897	29.856743	30.20772	2964	29.999916	29.817202	30.194912
2963	30.029416	29.857384	30.20804	2963	30.000408	29.817678	30.195793
2962	30.029862	29.85798	30.208458	2962	30.000901	29.818109	30.195895
2961	30.030307	29.858723	30.208674	2961	30.001394	29.818581	30.196175
2960	30.030753	29.859248	30.208998	2960	30.001887	29.819036	30.197359
2959	30.031198	29.86016	30.209353	2959	30.00238	29.819129	30.197853
2958	30.031644	29.860653	30.209733	2958	30.002873	29.819439	30.198634
2957	30.032089	29.861243	30.210016	2957	30.003365	29.820376	30.199227
2956	30.032535	29.862174	30.210373	2956	30.003858	29.820878	30.199691
2955	30.03298	29.862734	30.21059	2955	30.004351	29.821671	30.200162
2954	30.033426	29.863248	30.21104	2954	30.004844	29.821885	30.200727
2953	30.033871	29.863822	30.211374	2953	30.005337	29.822294	30.20144
2952	30.034317	29.864225	30.211724	2952	30.005829	29.82359	30.202313
2951	30.034762	29.8649	30.212086	2951	30.006322	29.824239	30.202792
2950	30.035208	29.865444	30.212416	2950	30.006815	29.824859	30.203088
2949	30.035654	29.865996	30.212751	2949	30.007308	29.825849	30.203498
2948	30.036099	29.866261	30.213087	2948	30.007801	29.826402	30.203939
2947	30.036545	29.867081	30.213399	2947	30.008294	29.827283	30.204395
2946	30.03699	29.867576	30.213648	2946	30.008786	29.827622	30.2046
2945	30.037436	29.868089	30.213936	2945	30.009279	29.828052	30.204847
2944	30.037881	29.868309	30.214297	2944	30.009772	29.828945	30.205308
2943	30.038327	29.86853	30.214581	2943	30.010265	29.82989	30.205404
2942	30.038772	29.869469	30.214982	2942	30.010758	29.830515	30.205667
2941	30.039218	29.869933	30.215456	2941	30.011251	29.830692	30.206075
2940	30.039663	29.870264	30.215693	2940	30.011743	29.831399	30.206286
2939	30.040109	29.870576	30.216131	2939	30.012236	29.831845	30.20659
2938	30.040554	29.870988	30.216556	2938	30.012729	29.832363	30.207093
2937	30.041	29.871716	30.216939	2937	30.013222	29.832945	30.20744
2936	30.041446	29.872277	30.2172	2936	30.013715	29.833461	30.207837
2935	30.041891	29.87269	30.217525	2935	30.014208	29.833955	30.208327
2934	30.042337	29.873697	30.217981	2934	30.0147	29.834289	30.209101
2933	30.042782	29.874319	30.218815	2933	30.015193	29.834526	30.20938
2932	30.043228	29.87483	30.219051	2932	30.015686	29.835137	30.209824
2931	30.043673	29.874928	30.219607	2931	30.016179	29.835305	30.210203
2930	30.044119	29.875207	30.220066	2930	30.016672	29.835461	30.210571
2929	30.044564	29.875634	30.22039	2929	30.017164	29.83564	30.210923
2928	30.04501	29.875896	30.22101	2928	30.017657	29.836063	30.211272
2927	30.045455	29.876378	30.22136	2927	30.01815	29.836409	30.2117
2926	30.045901	29.876499	30.222287	2926	30.018643	29.836758	30.212291
2925	30.046346	29.876569	30.223067	2925	30.019136	29.837123	30.212871
2924	30.046792	29.876639	30.223553	2924	30.019629	29.837763	30.213178
2923	30.047238	29.877424	30.223869	2923	30.020121	29.838195	30.213801
2922	30.047683	29.878131	30.223993	2922	30.020614	29.838353	30.214187
2921	30.048129	29.878256	30.224314	2921	30.021107	29.838505	30.214552
2920	30.048574	29.87846	30.224512	2920	30.0216	29.838837	30.214811
2919	30.04902	29.879219	30.224778	2919	30.022093	29.839383	30.215338
2918	30.049465	29.879476	30.225235	2918	30.022586	29.839633	30.215579
2917	30.049911	29.879915	30.225287	2917	30.023078	29.839894	30.215936
2916	30.050356	29.880599	30.225364	2916	30.023571	29.840952	30.216378
2915	30.050802	29.88071	30.225699	2915	30.024064	29.841082	30.216873
2914	30.051247	29.880974	30.226045	2914	30.024557	29.841913	30.217596
2913	30.051693	29.881514	30.226786	2913	30.02505	29.842447	30.21813
2912	30.052138	29.881663	30.227463	2912	30.025542	29.842805	30.218323
2911	30.052584	29.882109	30.228041	2911	30.026035	29.8429	30.218824
2910	30.05303	29.882313	30.228735	2910	30.026528	29.843091	30.219619
2909	30.053475	29.882823	30.229388	2909	30.027021	29.843659	30.220004
2908	30.053921	29.883165	30.229674	2908	30.027514	29.844324	30.220417

2907	30.054366	29.883922	30.230213	2907	30.028007	29.844906	30.220894
2906	30.054812	29.884513	30.230554	2906	30.028499	29.845522	30.221547
2905	30.055257	29.88499	30.230878	2905	30.028992	29.845701	30.221962
2904	30.055703	29.885297	30.231193	2904	30.029485	29.846065	30.222517
2903	30.056148	29.885609	30.231509	2903	30.029978	29.846593	30.223384
2902	30.056594	29.885931	30.232515	2902	30.030471	29.847004	30.22413
2901	30.057039	29.886234	30.233096	2901	30.030964	29.847468	30.224932
2900	30.057485	29.886674	30.233575	2900	30.031456	29.847974	30.225424
2899	30.057931	29.886903	30.234002	2899	30.031949	29.848386	30.22615
2898	30.058376	29.887394	30.234681	2898	30.032442	29.848535	30.226311
2897	30.058822	29.887734	30.235154	2897	30.032935	29.848697	30.227007
2896	30.059267	29.887997	30.235254	2896	30.033428	29.849099	30.227541
2895	30.059713	29.888399	30.235276	2895	30.033921	29.849141	30.228188
2894	30.060158	29.88861	30.236055	2894	30.034413	29.849707	30.228594
2893	30.060604	29.888926	30.23635	2893	30.034906	29.85027	30.229044
2892	30.061049	29.889223	30.236631	2892	30.035399	29.850619	30.229655
2891	30.061495	29.88947	30.23736	2891	30.035892	29.851162	30.229881
2890	30.06194	29.889796	30.237991	2890	30.036385	29.851742	30.230597
2889	30.062386	29.889941	30.238443	2889	30.036877	29.852213	30.231109
2888	30.062831	29.890173	30.239053	2888	30.03737	29.852756	30.231525
2887	30.063277	29.890739	30.239696	2887	30.037863	29.853032	30.232102
2886	30.063723	29.891088	30.240331	2886	30.038356	29.853726	30.232671
2885	30.064168	29.891596	30.241	2885	30.038849	29.854385	30.233079
2884	30.064614	29.891767	30.241674	2884	30.039342	29.85467	30.233401
2883	30.065059	29.892286	30.242347	2883	30.039834	29.855046	30.233861
2882	30.065505	29.892609	30.242839	2882	30.040327	29.855594	30.234341
2881	30.06595	29.892893	30.243313	2881	30.04082	29.855762	30.234803
2880	30.066396	29.89334	30.2438	2880	30.041313	29.856044	30.235279
2879	30.066841	29.893712	30.244394	2879	30.041806	29.85626	30.235746
2878	30.067287	29.894135	30.245039	2878	30.042299	29.856645	30.236323
2877	30.067732	29.894504	30.245465	2877	30.042791	29.856977	30.236952
2876	30.068178	29.894988	30.246179	2876	30.043284	29.857525	30.237609
2875	30.068623	29.895396	30.246708	2875	30.043777	29.858072	30.238119
2874	30.069069	29.895806	30.247187	2874	30.04427	29.858623	30.238638
2873	30.069515	29.895987	30.247437	2873	30.044763	29.859159	30.239261
2872	30.06996	29.896182	30.247818	2872	30.045255	29.859467	30.239907
2871	30.070406	29.896464	30.248681	2871	30.045748	29.859927	30.240552
2870	30.070851	29.896762	30.248959	2870	30.046241	29.860387	30.241204
2869	30.071297	29.896982	30.24985	2869	30.046734	29.860704	30.241861
2868	30.071742	29.897297	30.250466	2868	30.047227	29.860934	30.24271
2867	30.072188	29.897615	30.251082	2867	30.04772	29.861162	30.243161
2866	30.072633	29.897958	30.251733	2866	30.048212	29.86139	30.243805
2865	30.073079	29.898259	30.25258	2865	30.048705	29.861618	30.244165
2864	30.073524	29.898563	30.25282	2864	30.049198	29.861845	30.244483
2863	30.07397	29.898882	30.253533	2863	30.049691	29.862193	30.245652
2862	30.074415	29.899069	30.253965	2862	30.050184	29.862316	30.246678
2861	30.074861	29.899581	30.254529	2861	30.050677	29.8626	30.247481
2860	30.075307	29.899698	30.255263	2860	30.051169	29.862888	30.248083
2859	30.075752	29.89996	30.256169	2859	30.051662	29.863173	30.248585
2858	30.076198	29.900084	30.257002	2858	30.052155	29.863334	30.249199
2857	30.076643	29.900319	30.257514	2857	30.052648	29.86351	30.249928
2856	30.077089	29.900586	30.258493	2856	30.053141	29.863716	30.250769
2855	30.077534	29.901092	30.259466	2855	30.053633	29.86397	30.251244
2854	30.07798	29.901432	30.260199	2854	30.054126	29.864306	30.251602
2853	30.078425	29.901779	30.260568	2853	30.054619	29.864424	30.252246
2852	30.078871	29.902097	30.261055	2852	30.055112	29.86458	30.253056
2851	30.079316	29.902411	30.261532	2851	30.055605	29.864876	30.25384
2850	30.079762	29.902724	30.261806	2850	30.056098	29.865281	30.254429
2849	30.080207	29.902925	30.262078	2849	30.05659	29.865844	30.255286
2848	30.080653	29.903034	30.262338	2848	30.057083	29.866163	30.25606
2847	30.081099	29.903143	30.263048	2847	30.057576	29.866384	30.25673
2846	30.081544	29.903327	30.263732	2846	30.058069	29.866562	30.257342
2845	30.08199	29.903726	30.264563	2845	30.058562	29.866696	30.258224
2844	30.082457	29.904174	30.264992	2844	30.059054	29.867282	30.258625
2843	30.082923	29.905017	30.265387	2843	30.059547	29.868184	30.259029
2842	30.08339	29.905954	30.265722	2842	30.06004	29.868771	30.259445
2841	30.083857	29.906254	30.266181	2841	30.060532	29.869256	30.259862
2840	30.084324	29.906528	30.266841	2840	30.061025	29.869921	30.260461
2839	30.084791	29.907138	30.267409	2839	30.061517	29.870415	30.261064
2838	30.085258	29.907818	30.267713	2838	30.06201	29.870917	30.261631
2837	30.085725	29.908548	30.267943	2837	30.062503	29.871783	30.262051
2836	30.086192	29.909278	30.26821	2836	30.062995	29.872445	30.262283
2835	30.086659	29.910055	30.268676	2835	30.063488	29.872729	30.262797
2834	30.087125	29.910754	30.269177	2834	30.06398	29.873538	30.263152
2833	30.087592	29.911767	30.269341	2833	30.064473	29.874512	30.263849
2832	30.088059	29.912482	30.269506	2832	30.064966	29.874797	30.264489
2831	30.088526	29.913212	30.26964	2831	30.065458	29.875205	30.264878
2830	30.088993	29.913823	30.270016	2830	30.065951	29.876172	30.265267
2829	30.08946	29.914577	30.270326	2829	30.066444	29.876816	30.265656

2828	30.089927	29.914928	30.270608	2828	30.066936	29.87701	30.266062
2827	30.090394	29.915697	30.270798	2827	30.067429	29.877821	30.266546
2826	30.090861	29.916225	30.271104	2826	30.067921	29.878371	30.266841
2825	30.091327	29.916962	30.271492	2825	30.068414	29.878939	30.267411
2824	30.091794	29.917736	30.272118	2824	30.068907	29.879471	30.26783
2823	30.092261	29.918501	30.272691	2823	30.069399	29.879991	30.267974
2822	30.092728	29.919078	30.272972	2822	30.069892	29.88057	30.26836
2821	30.093195	29.919619	30.273275	2821	30.070384	29.881202	30.269106
2820	30.093662	29.920218	30.273626	2820	30.070877	29.881812	30.269651
2819	30.094129	29.920555	30.274059	2819	30.07137	29.882687	30.269737
2818	30.094596	29.920874	30.27459	2818	30.071862	29.883029	30.270414
2817	30.095063	29.921165	30.275136	2817	30.072355	29.883625	30.270603
2816	30.095529	29.921741	30.275535	2816	30.072848	29.884228	30.271265
2815	30.095996	29.922238	30.27603	2815	30.07334	29.884423	30.271842
2814	30.096463	29.923194	30.276408	2814	30.073833	29.884976	30.272456
2813	30.09693	29.923612	30.276768	2813	30.074325	29.885535	30.273355
2812	30.097397	29.924297	30.277115	2812	30.074818	29.886077	30.273837
2811	30.097864	29.924836	30.27737	2811	30.075311	29.886626	30.274319
2810	30.098331	29.925224	30.2776	2810	30.075803	29.887036	30.274809
2809	30.098798	29.925578	30.277943	2809	30.076296	29.887421	30.275111
2808	30.099265	29.925781	30.278496	2808	30.076788	29.887903	30.275312
2807	30.099731	29.926077	30.278638	2807	30.077281	29.888349	30.27551
2806	30.100198	29.926575	30.27915	2806	30.077774	29.888873	30.27617
2805	30.100665	29.926781	30.279439	2805	30.078266	29.889344	30.276825
2804	30.101132	29.927085	30.279691	2804	30.078759	29.88999	30.277426
2803	30.101599	29.927466	30.279922	2803	30.079252	29.890638	30.277886
2802	30.102066	29.928208	30.2803	2802	30.079744	29.890991	30.278228
2801	30.102533	29.928434	30.280842	2801	30.080237	29.891259	30.278652
2800	30.103	29.929177	30.281298	2800	30.080729	29.891527	30.279043
2799	30.103467	29.92945	30.281712	2799	30.081222	29.892121	30.2794
2798	30.103933	29.92992	30.282168	2798	30.081715	29.892591	30.279793
2797	30.1044	29.930374	30.28264	2797	30.082207	29.892601	30.280109
2796	30.104867	29.93086	30.283299	2796	30.0827	29.893374	30.280544
2795	30.105334	29.931355	30.283979	2795	30.083192	29.893767	30.281179
2794	30.105801	29.931922	30.28473	2794	30.083685	29.893957	30.281708
2793	30.106268	29.932488	30.285405	2793	30.084178	29.894323	30.282169
2792	30.106735	29.933008	30.285916	2792	30.08467	29.894621	30.283039
2791	30.107202	29.933613	30.286472	2791	30.085163	29.895115	30.283485
2790	30.107669	29.934165	30.28689	2790	30.085656	29.895794	30.284101
2789	30.108135	29.934562	30.28725	2789	30.086148	29.896486	30.284354
2788	30.108602	29.935093	30.287717	2788	30.086641	29.897033	30.285442
2787	30.109069	29.935425	30.288361	2787	30.087133	29.897631	30.286156
2786	30.109536	29.935989	30.288612	2786	30.087626	29.898005	30.286639
2785	30.110003	29.936552	30.28886	2785	30.088119	29.89841	30.287309
2784	30.11047	29.936995	30.28936	2784	30.088611	29.898777	30.287956
2783	30.110937	29.937387	30.289744	2783	30.089104	29.89908	30.288461
2782	30.111404	29.937754	30.290664	2782	30.089596	29.899387	30.288748
2781	30.111871	29.938344	30.291097	2781	30.090089	29.899681	30.289328
2780	30.112337	29.938765	30.29136	2780	30.090582	29.899976	30.290119
2779	30.112804	29.939198	30.291949	2779	30.091074	29.900161	30.291264
2778	30.113271	29.93967	30.292626	2778	30.091567	29.900287	30.291345
2777	30.113738	29.940171	30.293524	2777	30.092059	29.900566	30.292276
2776	30.114205	29.940547	30.294042	2776	30.092552	29.901093	30.292868
2775	30.114672	29.94107	30.294269	2775	30.093045	29.901473	30.293613
2774	30.115139	29.94147	30.295133	2774	30.093537	29.901774	30.293829
2773	30.115606	29.94212	30.2958	2773	30.09403	29.902075	30.294584
2772	30.116073	29.942642	30.296271	2772	30.094523	29.902372	30.295481
2771	30.116539	29.943097	30.29693	2771	30.095015	29.902687	30.296211
2770	30.117006	29.943146	30.297296	2770	30.095508	29.903412	30.296739
2769	30.117473	29.943505	30.298046	2769	30.096	29.903989	30.297021
2768	30.11794	29.944064	30.298678	2768	30.096493	29.904555	30.297836
2767	30.118407	29.944705	30.299205	2767	30.096986	29.905118	30.298756
2766	30.118874	29.944868	30.300128	2766	30.097478	29.905736	30.299591
2765	30.119341	29.945023	30.300511	2765	30.097971	29.906328	30.299948
2764	30.119808	29.945392	30.300924	2764	30.098463	29.906697	30.300491
2763	30.120275	29.945794	30.301505	2763	30.098956	29.90695	30.300827
2762	30.120741	29.94616	30.302184	2762	30.099449	29.90749	30.301487
2761	30.121208	29.946554	30.302625	2761	30.099941	29.908191	30.301938
2760	30.121675	29.946921	30.303203	2760	30.100434	29.908734	30.302405
2759	30.122142	29.947314	30.303924	2759	30.100927	29.90901	30.302607
2758	30.122609	29.947726	30.304488	2758	30.101419	29.909413	30.302828
2757	30.123076	29.948093	30.304907	2757	30.101912	29.90969	30.303791
2756	30.123543	29.948323	30.305255	2756	30.102404	29.909916	30.3046
2755	30.12401	29.948776	30.305493	2755	30.102897	29.910383	30.305051
2754	30.124477	29.949133	30.306225	2754	30.10339	29.910674	30.30593
2753	30.124943	29.949659	30.307028	2753	30.103882	29.910963	30.306381
2752	30.12541	29.950045	30.307311	2752	30.104375	29.911348	30.306981
2751	30.125877	29.950208	30.307862	2751	30.104867	29.911956	30.307905
2750	30.126344	29.950735	30.308435	2750	30.10536	29.912055	30.309337

2749	30.126811	29.951214	30.308961	2749	30.105853	29.912518	30.310499
2748	30.127278	29.951416	30.309343	2748	30.106345	29.913191	30.311129
2747	30.127745	29.952005	30.309838	2747	30.106838	29.91376	30.312138
2746	30.128212	29.952394	30.310912	2746	30.107331	29.914047	30.312409
2745	30.128679	29.952548	30.311135	2745	30.107823	29.91428	30.313046
2744	30.129145	29.952629	30.311422	2744	30.108316	29.914508	30.313893
2743	30.129612	29.953021	30.312527	2743	30.108808	29.914628	30.314681
2742	30.130079	29.953465	30.313225	2742	30.109301	29.91511	30.31539
2741	30.130546	29.953919	30.313977	2741	30.109794	29.915237	30.316321
2740	30.131013	29.954286	30.314373	2740	30.110286	29.915804	30.316971
2739	30.13148	29.954512	30.315292	2739	30.110779	29.916458	30.317458
2738	30.131947	29.954738	30.31587	2738	30.111271	29.916652	30.318377
2737	30.132414	29.954964	30.316324	2737	30.111764	29.916843	30.319051
2736	30.132881	29.955304	30.317123	2736	30.112257	29.917031	30.319507
2735	30.133347	29.955581	30.318349	2735	30.112749	29.917809	30.32067
2734	30.133814	29.956154	30.318787	2734	30.113242	29.918493	30.321753
2733	30.134281	29.95641	30.319475	2733	30.113734	29.919116	30.322479
2732	30.134748	29.956586	30.320236	2732	30.114227	29.919279	30.322543
2731	30.135215	29.956977	30.321464	2731	30.11472	29.919862	30.32357
2730	30.135682	29.957364	30.322031	2730	30.115212	29.92083	30.324702
2729	30.136149	29.957685	30.322639	2729	30.115705	29.92124	30.325101
2728	30.136616	29.957908	30.323044	2728	30.116198	29.921644	30.325596
2727	30.137083	29.958198	30.323565	2727	30.11669	29.921963	30.326458
2726	30.137549	29.958402	30.323929	2726	30.117183	29.922191	30.327692
2725	30.138016	29.958933	30.324666	2725	30.117675	29.922462	30.328588
2724	30.138483	29.959515	30.325028	2724	30.118168	29.923159	30.329278
2723	30.13895	29.959726	30.325544	2723	30.118661	29.923682	30.330439
2722	30.139417	29.959883	30.326036	2722	30.119153	29.924089	30.331554
2721	30.139884	29.960321	30.326693	2721	30.119646	29.924345	30.332485
2720	30.140351	29.960461	30.327287	2720	30.120138	29.924882	30.333202
2719	30.140804	29.961133	30.327471	2719	30.120633	29.925304	30.334467
2718	30.141258	29.961877	30.327833	2718	30.121127	29.925688	30.334638
2717	30.141711	29.962331	30.328281	2717	30.121622	29.926126	30.33481
2716	30.142165	29.962648	30.328867	2716	30.122116	29.926611	30.335155
2715	30.142618	29.963303	30.329199	2715	30.122611	29.927042	30.335742
2714	30.143072	29.963809	30.329705	2714	30.123105	29.928114	30.336047
2713	30.143525	29.964501	30.33024	2713	30.123599	29.929319	30.336404
2712	30.143979	29.964918	30.33054	2712	30.124094	29.929543	30.336625
2711	30.144432	29.965576	30.331048	2711	30.124588	29.929824	30.33691
2710	30.144886	29.966047	30.331344	2710	30.125083	29.930636	30.337839
2709	30.145339	29.966994	30.331777	2709	30.125577	29.931308	30.338036
2708	30.145793	29.967373	30.332117	2708	30.126072	29.93175	30.338232
2707	30.146246	29.968056	30.332443	2707	30.126566	29.932206	30.338431
2706	30.1467	29.96881	30.332768	2706	30.12706	29.932976	30.338853
2705	30.147153	29.969665	30.333094	2705	30.127555	29.933419	30.339223
2704	30.147607	29.970635	30.333419	2704	30.128049	29.93405	30.339836
2703	30.14806	29.971543	30.333764	2703	30.128544	29.934454	30.340283
2702	30.148514	29.971942	30.334107	2702	30.129038	29.935008	30.340804
2701	30.148967	29.972183	30.334386	2701	30.129532	29.935713	30.341331
2700	30.149421	29.972605	30.334632	2700	30.130027	29.936373	30.341454
2699	30.149875	29.973084	30.334894	2699	30.130521	29.937043	30.341527
2698	30.150328	29.973917	30.335266	2698	30.131016	29.937797	30.34244
2697	30.150782	29.974447	30.33566	2697	30.13151	29.938338	30.342676
2696	30.151235	29.975045	30.33606	2696	30.132005	29.93867	30.34312
2695	30.151689	29.975796	30.33634	2695	30.132499	29.939169	30.343353
2694	30.152142	29.976239	30.336461	2694	30.132993	29.939608	30.343493
2693	30.152596	29.976551	30.336538	2693	30.133488	29.940302	30.343633
2692	30.153049	29.977089	30.336648	2692	30.133982	29.941169	30.344077
2691	30.153503	29.977696	30.336846	2691	30.134477	29.942224	30.344482
2690	30.153956	29.978168	30.337085	2690	30.134971	29.942375	30.344826
2689	30.15441	29.978459	30.337446	2689	30.135465	29.943003	30.345174
2688	30.154863	29.978807	30.337711	2688	30.13596	29.943351	30.345761
2687	30.155317	29.979254	30.33797	2687	30.136454	29.943862	30.346246
2686	30.15577	29.980185	30.338234	2686	30.136949	29.944384	30.346351
2685	30.156224	29.980531	30.338518	2685	30.137443	29.94504	30.34676
2684	30.156677	29.981197	30.338802	2684	30.137938	29.945086	30.346949
2683	30.157131	29.981647	30.339096	2683	30.138432	29.945576	30.347332
2682	30.157584	29.982726	30.339466	2682	30.138926	29.945963	30.348198
2681	30.158038	29.982917	30.339951	2681	30.139421	29.94615	30.3483
2680	30.158491	29.983141	30.340349	2680	30.139915	29.94636	30.348674
2679	30.158945	29.983445	30.340969	2679	30.14041	29.946531	30.349484
2678	30.159398	29.983791	30.341326	2678	30.140904	29.947087	30.349885
2677	30.159852	29.984001	30.342006	2677	30.141399	29.947666	30.350493
2676	30.160305	29.984251	30.342672	2676	30.141893	29.948533	30.351099
2675	30.160759	29.984679	30.343023	2675	30.142387	29.949445	30.351678
2674	30.161212	29.985124	30.343337	2674	30.142882	29.950002	30.352121
2673	30.161666	29.985634	30.34346	2673	30.143376	29.95025	30.352906
2672	30.162119	29.98591	30.344021	2672	30.143871	29.950436	30.353328
2671	30.162573	29.98646	30.344368	2671	30.144365	29.950632	30.353487

2670	30.163026	29.987267	30.344662	2670	30.144859	29.951027	30.35367
2669	30.16348	29.987619	30.345045	2669	30.145354	29.952345	30.354309
2668	30.163933	29.987913	30.345523	2668	30.145848	29.9538	30.354649
2667	30.164387	29.988258	30.345982	2667	30.146343	29.954499	30.354991
2666	30.16484	29.989374	30.346155	2666	30.146837	29.955034	30.355306
2665	30.165294	29.989741	30.34655	2665	30.147332	29.955221	30.356253
2664	30.165747	29.99031	30.347218	2664	30.147826	29.955422	30.357038
2663	30.166201	29.99081	30.347396	2663	30.14832	29.955729	30.357515
2662	30.166654	29.991274	30.347568	2662	30.148815	29.956085	30.357744
2661	30.167108	29.991723	30.347775	2661	30.149309	29.956648	30.358305
2660	30.167561	29.991926	30.348401	2660	30.149804	29.956738	30.358828
2659	30.168015	29.992428	30.349032	2659	30.150298	29.956967	30.359097
2658	30.168469	29.9932	30.349647	2658	30.150793	29.957256	30.359772
2657	30.168922	29.99326	30.350033	2657	30.151287	29.957471	30.360511
2656	30.169376	29.993772	30.350339	2656	30.151781	29.957719	30.361187
2655	30.169829	29.994047	30.350685	2655	30.152276	29.957968	30.362076
2654	30.170283	29.994265	30.351345	2654	30.15277	29.958268	30.362856
2653	30.170736	29.994562	30.351996	2653	30.153265	29.958528	30.363213
2652	30.171119	29.995018	30.352585	2652	30.153759	29.958783	30.363502
2651	30.171643	29.995314	30.353348	2651	30.154253	29.959011	30.36374
2650	30.172097	29.995684	30.354006	2650	30.154748	29.959312	30.3644
2649	30.17255	29.996251	30.354672	2649	30.155242	29.959944	30.364487
2648	30.173004	29.996427	30.355301	2648	30.155737	29.960353	30.364776
2647	30.173457	29.996602	30.355732	2647	30.156231	29.960689	30.365205
2646	30.173911	29.997056	30.356074	2646	30.156726	29.961378	30.36576
2645	30.174364	29.997643	30.35658	2645	30.15722	29.961978	30.366062
2644	30.174818	29.997946	30.357552	2644	30.157714	29.962229	30.366427
2643	30.175271	29.99807	30.358162	2643	30.158209	29.962994	30.367062
2642	30.175725	29.998195	30.358665	2642	30.158703	29.963272	30.367549
2641	30.176178	29.998674	30.359388	2641	30.159198	29.963547	30.36835
2640	30.176632	29.999353	30.3602	2640	30.159692	29.963822	30.369068
2639	30.177085	29.999924	30.360436	2639	30.160187	29.964353	30.369628
2638	30.177539	30.000495	30.360622	2638	30.160681	29.964623	30.370009
2637	30.177992	30.000936	30.361168	2637	30.161175	29.964782	30.370396
2636	30.178446	30.001158	30.362009	2636	30.16167	29.965045	30.371071
2635	30.178899	30.001385	30.362416	2635	30.162164	29.965406	30.371334
2634	30.179353	30.001496	30.362843	2634	30.162659	29.965649	30.371564
2633	30.179806	30.001808	30.363104	2633	30.163153	29.966107	30.371797
2632	30.18026	30.002028	30.363786	2632	30.163647	29.966551	30.372529
2631	30.180713	30.00258	30.364452	2631	30.164142	29.96699	30.373277
2630	30.181167	30.003114	30.365082	2630	30.164636	29.967427	30.373429
2629	30.18162	30.003427	30.365805	2629	30.165131	29.96795	30.373931
2628	30.182074	30.003879	30.366305	2628	30.165625	29.968448	30.374598
2627	30.182527	30.004346	30.366714	2627	30.16612	29.968959	30.375121
2626	30.182981	30.004646	30.367078	2626	30.166614	29.969714	30.375802
2625	30.183434	30.0051	30.367673	2625	30.167108	29.970018	30.376495
2624	30.183888	30.005547	30.367922	2624	30.167603	29.970346	30.37718
2623	30.184341	30.005905	30.368473	2623	30.168097	29.971146	30.377864
2622	30.184795	30.006379	30.3688	2622	30.168592	29.97199	30.378102
2621	30.185248	30.006742	30.369128	2621	30.169086	29.972643	30.378768
2620	30.185702	30.007016	30.369511	2620	30.16958	29.973005	30.379441
2619	30.186155	30.007279	30.369916	2619	30.170075	29.973405	30.379894
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2617	30.187062	30.007571	30.370853	2617	30.171064	29.974362	30.3811
2616	30.187516	30.008164	30.371184	2616	30.171558	29.974685	30.381799
2615	30.18797	30.008769	30.372055	2615	30.172053	29.974976	30.382799
2614	30.188423	30.008878	30.372703	2614	30.172547	29.975365	30.383458
2613	30.188877	30.009053	30.373269	2613	30.173041	29.976314	30.384361
2612	30.18933	30.009282	30.37443	2612	30.173536	29.976865	30.385177
2611	30.189784	30.009605	30.374901	2611	30.17403	29.977419	30.385507
2610	30.190237	30.009904	30.375344	2610	30.174525	29.977792	30.386092
2609	30.190691	30.010178	30.375936	2609	30.175019	29.978126	30.386731
2608	30.191144	30.010584	30.376534	2608	30.175514	29.978296	30.387316
2607	30.191598	30.010993	30.376878	2607	30.176008	29.978467	30.388211
2606	30.192051	30.011265	30.377545	2606	30.176502	29.978638	30.389249
2605	30.192505	30.011523	30.378366	2605	30.176997	29.979034	30.389664
2604	30.192958	30.011781	30.379008	2604	30.177491	29.979862	30.390284
2603	30.193412	30.012246	30.379781	2603	30.177986	29.98017	30.390859
2602	30.193865	30.012429	30.380169	2602	30.17848	29.980247	30.391405
2601	30.194319	30.012555	30.381129	2601	30.178974	29.980617	30.391613
2600	30.194772	30.01271	30.381878	2600	30.179469	29.980803	30.392148
2599	30.195226	30.013123	30.382103	2599	30.179963	29.981068	30.392987
2598	30.195679	30.013418	30.382915	2598	30.180458	29.981288	30.393676
2597	30.196133	30.013822	30.383141	2597	30.180952	29.981546	30.394851
2596	30.196586	30.014241	30.383433	2596	30.181447	29.981747	30.395226
2595	30.19704	30.01449	30.384489	2595	30.181941	29.982138	30.396026
2594	30.197497	30.015224	30.384863	2594	30.182427	29.983007	30.396392
2593	30.197955	30.015677	30.385187	2593	30.182913	29.983569	30.39667
2592	30.198412	30.016136	30.385493	2592	30.183399	29.98397	30.397112

2591	30.198869	30.01665	30.386112	2591	30.183886	29.984635	30.397621
2590	30.199327	30.017273	30.386562	2590	30.184372	29.98535	30.397975
2589	30.199784	30.018108	30.386834	2589	30.184858	29.985817	30.398568
2588	30.200242	30.018755	30.387219	2588	30.185344	29.986042	30.398876
2587	30.200699	30.019094	30.387497	2587	30.18583	29.986554	30.399515
2586	30.201156	30.019731	30.387821	2586	30.186316	29.987217	30.400045
2585	30.201614	30.020436	30.388268	2585	30.186802	29.987862	30.400538
2584	30.202071	30.020751	30.388721	2584	30.187289	29.988525	30.400951
2583	30.202529	30.021139	30.38903	2583	30.187775	29.989477	30.401186
2582	30.202986	30.021728	30.389192	2582	30.188261	29.989987	30.401519
2581	30.203443	30.02234	30.389377	2581	30.188747	29.990496	30.402182
2580	30.203901	30.022963	30.389925	2580	30.189233	29.991125	30.402535
2579	30.204358	30.02336	30.390275	2579	30.189719	29.991814	30.40279
2578	30.204816	30.024139	30.390624	2578	30.190206	29.993086	30.403155
2577	30.205273	30.024752	30.391255	2577	30.190692	29.994033	30.403795
2576	30.20573	30.025324	30.391615	2576	30.191178	29.994313	30.404065
2575	30.206188	30.025808	30.391931	2575	30.191664	29.994581	30.404223
2574	30.206645	30.026247	30.392413	2574	30.19215	29.995071	30.404706
2573	30.207103	30.02674	30.392881	2573	30.192636	29.995668	30.405189
2572	30.20756	30.027346	30.39297	2572	30.193122	29.995797	30.405591
2571	30.208017	30.028214	30.393146	2571	30.193609	29.99635	30.406162
2570	30.208475	30.028897	30.393692	2570	30.194095	29.996669	30.406639
2569	30.208932	30.029499	30.394307	2569	30.194581	29.997031	30.406976
2568	30.20939	30.030267	30.394957	2568	30.195067	29.997319	30.407467
2567	30.209847	30.031049	30.395167	2567	30.195553	29.997479	30.407801
2566	30.210304	30.031669	30.395367	2566	30.196039	29.998161	30.408514
2565	30.210762	30.03274	30.395572	2565	30.196525	29.999058	30.408679
2564	30.211219	30.03327	30.395787	2564	30.197012	29.999964	30.409352
2563	30.211677	30.034073	30.396241	2563	30.197498	30.00039	30.409637
2562	30.212134	30.034544	30.396838	2562	30.197984	30.000814	30.410294
2561	30.212592	30.035106	30.39751	2561	30.19847	30.001291	30.410945
2560	30.213049	30.035858	30.397858	2560	30.198956	30.001642	30.411525
2559	30.213506	30.036381	30.398205	2559	30.199442	30.002063	30.411775
2558	30.213964	30.036901	30.398786	2558	30.199929	30.003279	30.41208
2557	30.214421	30.03722	30.398965	2557	30.200415	30.003835	30.412297
2556	30.214879	30.03754	30.399136	2556	30.200901	30.004071	30.41251
2555	30.215336	30.03791	30.399446	2555	30.201387	30.004308	30.41295
2554	30.215793	30.038429	30.39976	2554	30.201873	30.004801	30.413409
2553	30.216251	30.038889	30.400071	2553	30.202359	30.005077	30.414067
2552	30.216708	30.039268	30.400354	2552	30.202845	30.005129	30.414688
2551	30.217166	30.039873	30.400763	2551	30.203332	30.005245	30.414959
2550	30.217623	30.040466	30.401417	2550	30.203818	30.005503	30.415363
2549	30.21808	30.041295	30.402012	2549	30.204304	30.006099	30.415839
2548	30.218538	30.041806	30.40246	2548	30.20479	30.006365	30.416193
2547	30.218995	30.042308	30.403113	2547	30.205276	30.006503	30.416606
2546	30.219453	30.042939	30.403454	2546	30.205762	30.006863	30.416929
2545	30.21991	30.043242	30.403702	2545	30.206248	30.007176	30.417253
2544	30.220367	30.043303	30.403995	2544	30.206735	30.007308	30.417589
2543	30.220825	30.043344	30.404924	2543	30.207221	30.00744	30.418157
2542	30.221282	30.043826	30.40563	2542	30.207707	30.008383	30.41847
2541	30.22174	30.044489	30.406033	2541	30.208193	30.008733	30.418773
2540	30.222197	30.044968	30.40682	2540	30.208679	30.009036	30.419112
2539	30.222654	30.045758	30.407065	2539	30.209165	30.009349	30.419842
2538	30.223112	30.045928	30.407398	2538	30.209652	30.009763	30.420098
2537	30.223569	30.046055	30.407851	2537	30.210138	30.010287	30.421018
2536	30.224027	30.046225	30.408195	2536	30.210624	30.011069	30.421404
2535	30.224484	30.04697	30.408851	2535	30.21111	30.011975	30.421802
2534	30.224941	30.047302	30.409287	2534	30.211596	30.012432	30.422539
2533	30.225399	30.047838	30.409873	2533	30.212082	30.012859	30.422944
2532	30.225856	30.048301	30.41041	2532	30.212568	30.013953	30.423494
2531	30.226314	30.048929	30.410952	2531	30.213055	30.014813	30.42394
2530	30.226771	30.049303	30.411428	2530	30.213541	30.014949	30.424278
2529	30.227228	30.049444	30.411591	2529	30.214027	30.015084	30.424666
2528	30.227686	30.050123	30.412064	2528	30.214513	30.015703	30.425146
2527	30.228143	30.05032	30.412405	2527	30.214999	30.015953	30.425576
2526	30.228601	30.050499	30.412473	2526	30.215485	30.016362	30.426294
2525	30.229058	30.050755	30.412567	2525	30.215971	30.016973	30.427017
2524	30.229515	30.050928	30.412875	2524	30.216458	30.01776	30.427807
2523	30.229973	30.051471	30.413423	2523	30.216944	30.018355	30.428591
2522	30.23043	30.052056	30.414228	2522	30.21743	30.018623	30.429155
2521	30.230888	30.052527	30.414639	2521	30.217916	30.01904	30.429916
2520	30.231345	30.053443	30.415303	2520	30.218402	30.019521	30.430329
2519	30.231802	30.054416	30.415881	2519	30.218888	30.0202	30.431174
2518	30.23226	30.055043	30.416027	2518	30.219375	30.02032	30.431627
2517	30.232717	30.055395	30.416633	2517	30.219861	30.020463	30.431924
2516	30.233175	30.056049	30.417287	2516	30.220347	30.020479	30.432143
2515	30.233632	30.056325	30.417589	2515	30.220833	30.020906	30.432397
2514	30.234089	30.056583	30.418536	2514	30.221319	30.021019	30.43265
2513	30.234547	30.057179	30.419509	2513	30.221805	30.021219	30.433121

2512	30.235004	30.057523	30.420244	2512	30.222291	30.021517	30.433695
2511	30.235462	30.057876	30.420652	2511	30.222778	30.021823	30.43478
2510	30.235919	30.058223	30.42099	2510	30.223264	30.021984	30.435287
2509	30.236377	30.058375	30.42132	2509	30.22375	30.022136	30.435416
2508	30.236834	30.058578	30.421729	2508	30.224236	30.022808	30.435925
2507	30.237291	30.058842	30.422613	2507	30.224722	30.022312	30.436241
2506	30.237749	30.059123	30.422999	2506	30.225208	30.023654	30.43716
2505	30.238206	30.059438	30.424027	2505	30.225694	30.023956	30.437978
2504	30.238664	30.059604	30.424234	2504	30.226181	30.024349	30.438515
2503	30.239121	30.059961	30.424909	2503	30.226667	30.024649	30.439152
2502	30.239578	30.060132	30.425598	2502	30.227153	30.025119	30.439807
2501	30.240036	30.060449	30.426408	2501	30.227639	30.025626	30.440396
2500	30.240493	30.06063	30.427333	2500	30.228125	30.025807	30.440883
2499	30.240951	30.060952	30.428387	2499	30.228611	30.025921	30.441443
2498	30.241408	30.061174	30.429098	2498	30.229098	30.026095	30.441651
2497	30.241865	30.061337	30.429972	2497	30.229584	30.026462	30.442161
2496	30.242323	30.061798	30.430706	2496	30.23007	30.026597	30.44273
2495	30.24278	30.06226	30.431421	2495	30.230556	30.027313	30.44335
2494	30.243238	30.062722	30.431928	2494	30.231042	30.02762	30.443828
2493	30.243695	30.063162	30.432496	2493	30.231528	30.028129	30.444512
2492	30.244152	30.063346	30.432902	2492	30.232014	30.029122	30.445207
2491	30.24461	30.063471	30.433449	2491	30.232501	30.029568	30.445869
2490	30.245067	30.063754	30.434011	2490	30.232987	30.029739	30.446263
2489	30.245525	30.063954	30.434622	2489	30.233473	30.029913	30.446437
2488	30.245982	30.06411	30.435599	2488	30.233959	30.030364	30.44703
2487	30.246439	30.064361	30.436423	2487	30.234445	30.030611	30.4479
2486	30.246897	30.064786	30.436817	2486	30.234931	30.030931	30.448607
2485	30.247354	30.065025	30.437506	2485	30.235417	30.03138	30.448914
2484	30.247812	30.065341	30.43831	2484	30.235904	30.031999	30.44922
2483	30.248269	30.065697	30.438652	2483	30.23639	30.032268	30.449662
2482	30.248726	30.066075	30.439388	2482	30.236876	30.032347	30.450286
2481	30.249184	30.066459	30.43969	2481	30.237362	30.032578	30.450793
2480	30.249641	30.066917	30.440485	2480	30.237848	30.033249	30.452049
2479	30.250099	30.067465	30.441067	2479	30.238334	30.033915	30.452725
2478	30.250556	30.067915	30.442043	2478	30.238821	30.034525	30.45407
2477	30.251013	30.068193	30.442388	2477	30.239307	30.034982	30.455198
2476	30.251471	30.068405	30.443052	2476	30.239793	30.035439	30.455701
2475	30.251928	30.068777	30.443775	2475	30.240279	30.035892	30.456261
2474	30.252386	30.069047	30.444158	2474	30.240765	30.036335	30.457199
2473	30.252843	30.069154	30.444943	2473	30.241251	30.036696	30.457696
2472	30.2533	30.069406	30.445969	2472	30.241737	30.036925	30.4583
2471	30.253758	30.069887	30.446672	2471	30.242224	30.037066	30.459084
2470	30.254215	30.070136	30.447768	2470	30.24271	30.037202	30.459893
2469	30.254702	30.070829	30.447987	2469	30.243214	30.038557	30.460447
2468	30.255188	30.071422	30.448227	2468	30.243718	30.038981	30.460757
2467	30.255675	30.072141	30.448442	2467	30.244221	30.039397	30.461225
2466	30.256161	30.072633	30.448739	2466	30.244725	30.03991	30.461589
2465	30.256648	30.073067	30.449071	2465	30.245229	30.040496	30.461916
2464	30.257134	30.073653	30.449228	2464	30.245733	30.041105	30.462143
2463	30.257621	30.074532	30.449431	2463	30.246237	30.041381	30.462403
2462	30.258107	30.075387	30.44988	2462	30.246741	30.041818	30.462595
2461	30.258594	30.075894	30.450394	2461	30.247245	30.042672	30.462931
2460	30.25908	30.076309	30.451055	2460	30.247749	30.043288	30.463482
2459	30.259567	30.076909	30.452007	2459	30.248252	30.043594	30.464075
2458	30.260053	30.07754	30.452576	2458	30.248756	30.044171	30.464511
2457	30.260539	30.078066	30.453018	2457	30.24926	30.044393	30.464913
2456	30.261026	30.078816	30.453463	2456	30.249764	30.045374	30.465555
2455	30.261512	30.079335	30.45398	2455	30.250268	30.045646	30.466078
2454	30.261999	30.080057	30.45468	2454	30.250772	30.046428	30.4666
2453	30.262485	30.080741	30.455284	2453	30.251276	30.046945	30.467167
2452	30.262972	30.081465	30.455571	2452	30.25178	30.047204	30.467815
2451	30.263458	30.082035	30.45603	2451	30.252284	30.047452	30.468424
2450	30.263945	30.082378	30.45639	2450	30.252787	30.047938	30.468882
2449	30.264431	30.082947	30.45701	2449	30.253291	30.048655	30.469473
2448	30.264918	30.083584	30.45719	2448	30.253795	30.049769	30.469875
2447	30.265404	30.084179	30.45737	2447	30.254299	30.050592	30.470301
2446	30.265891	30.084626	30.457566	2446	30.254803	30.051051	30.470626
2445	30.266377	30.085073	30.45809	2445	30.255307	30.051581	30.470897
2444	30.266864	30.085606	30.458772	2444	30.255811	30.052083	30.47152
2443	30.26735	30.085997	30.459606	2443	30.256315	30.053025	30.4721
2442	30.267837	30.086422	30.46012	2442	30.256818	30.053608	30.47268
2441	30.268323	30.086859	30.460595	2441	30.257322	30.053983	30.47326
2440	30.26881	30.087623	30.461249	2440	30.257826	30.054122	30.473848
2439	30.269296	30.088046	30.461535	2439	30.25833	30.054677	30.474435
2438	30.269783	30.088763	30.46182	2438	30.258834	30.055027	30.475015
2437	30.270269	30.08899	30.462106	2437	30.259338	30.055517	30.475257
2436	30.270755	30.089235	30.462644	2436	30.259842	30.055899	30.475317
2435	30.271242	30.090239	30.462919	2435	30.260346	30.056442	30.475551
2434	30.271728	30.090561	30.463446	2434	30.26085	30.056874	30.476381

2433	30.272215	30.091391	30.463665	2433	30.261353	30.057612	30.477485
2432	30.272701	30.092003	30.46406	2432	30.261857	30.05782	30.477994
2431	30.273188	30.092752	30.464599	2431	30.262361	30.058273	30.478716
2430	30.273674	30.09331	30.464764	2430	30.262865	30.058557	30.479116
2429	30.274161	30.094067	30.465932	2429	30.263369	30.058908	30.479456
2428	30.274647	30.094337	30.466323	2428	30.263873	30.059144	30.479803
2427	30.275134	30.094564	30.466546	2427	30.264377	30.059374	30.480302
2426	30.27562	30.095053	30.466769	2426	30.264881	30.059716	30.480492
2425	30.276107	30.09542	30.466957	2425	30.265384	30.060092	30.481419
2424	30.276593	30.095855	30.467511	2424	30.265888	30.060264	30.48155
2423	30.27708	30.096187	30.468014	2423	30.266392	30.060858	30.481682
2422	30.277566	30.096434	30.468153	2422	30.266896	30.06125	30.481814
2421	30.278053	30.096717	30.468601	2421	30.2674	30.061836	30.482202
2420	30.278539	30.097334	30.469495	2420	30.267904	30.062004	30.482964
2419	30.279026	30.097913	30.470111	2419	30.268408	30.062166	30.483173
2418	30.279512	30.098263	30.470363	2418	30.268912	30.062729	30.484677
2417	30.279999	30.098711	30.471066	2417	30.269416	30.063032	30.484803
2416	30.280485	30.099308	30.471599	2416	30.269919	30.063225	30.48526
2415	30.280971	30.099673	30.471819	2415	30.270423	30.063578	30.485892
2414	30.281458	30.10023	30.472516	2414	30.270927	30.063833	30.486021
2413	30.281944	30.100909	30.47294	2413	30.271431	30.064471	30.48628
2412	30.282431	30.101445	30.473841	2412	30.271935	30.064726	30.486981
2411	30.282917	30.10179	30.474379	2411	30.272439	30.065032	30.487685
2410	30.283404	30.102321	30.475169	2410	30.272943	30.065692	30.488436
2409	30.28389	30.102692	30.475671	2409	30.273447	30.066262	30.489281
2408	30.284377	30.103047	30.476153	2408	30.27395	30.066585	30.489891
2407	30.284863	30.103524	30.476782	2407	30.274454	30.066989	30.490599
2406	30.28535	30.1043	30.477208	2406	30.274958	30.067445	30.491006
2405	30.285836	30.10473	30.477937	2405	30.275462	30.067826	30.491428
2404	30.286323	30.104936	30.478241	2404	30.275966	30.068306	30.492044
2403	30.286809	30.105339	30.479015	2403	30.27647	30.069035	30.492789
2402	30.287296	30.106075	30.479914	2402	30.276974	30.069441	30.49386
2401	30.287782	30.106733	30.481049	2401	30.277478	30.069814	30.494386
2400	30.288269	30.107174	30.481609	2400	30.277981	30.070441	30.495048
2399	30.288755	30.107459	30.481866	2399	30.278485	30.071133	30.49598
2398	30.289242	30.107684	30.482623	2398	30.278989	30.071824	30.496772
2397	30.289728	30.10798	30.482866	2397	30.279493	30.072379	30.497792
2396	30.290215	30.108292	30.483159	2396	30.279997	30.073009	30.498377
2395	30.290701	30.108612	30.483968	2395	30.280501	30.073555	30.499172
2394	30.291187	30.109006	30.484424	2394	30.281005	30.074089	30.499478
2393	30.291674	30.109866	30.485863	2393	30.281509	30.074628	30.499557
2392	30.29216	30.11033	30.486497	2392	30.282013	30.074774	30.499635
2391	30.292647	30.110797	30.486742	2391	30.282516	30.075029	30.499787
2390	30.293133	30.111025	30.487041	2390	30.28302	30.075421	30.501093
2389	30.29362	30.111282	30.487816	2389	30.283524	30.076063	30.501574
2388	30.294106	30.112015	30.488812	2388	30.284028	30.076694	30.502154
2387	30.294593	30.112519	30.489333	2387	30.284532	30.07696	30.503084
2386	30.295079	30.112902	30.489933	2386	30.285036	30.077064	30.503746
2385	30.295566	30.113205	30.49092	2385	30.28554	30.077158	30.504498
2384	30.296052	30.113513	30.491747	2384	30.286044	30.077391	30.504894
2383	30.296539	30.113747	30.492587	2383	30.286547	30.077976	30.505291
2382	30.297025	30.113894	30.493351	2382	30.287051	30.078417	30.505766
2381	30.297512	30.114039	30.494137	2381	30.287555	30.078567	30.506169
2380	30.297998	30.114213	30.494773	2380	30.288059	30.078727	30.506574
2379	30.298485	30.114584	30.495346	2379	30.288563	30.07888	30.507044
2378	30.298971	30.115386	30.496535	2378	30.289067	30.079394	30.507866
2377	30.299458	30.115697	30.497491	2377	30.289571	30.079938	30.508754
2376	30.299944	30.115718	30.498114	2376	30.290075	30.080483	30.509224
2375	30.300431	30.115923	30.499108	2375	30.290579	30.081027	30.509247
2374	30.300917	30.11628	30.500089	2374	30.291082	30.081571	30.509911
2373	30.301404	30.116703	30.50084	2373	30.291586	30.082116	30.511116
2372	30.30189	30.116969	30.501747	2372	30.29209	30.082672	30.512034
2371	30.302376	30.117351	30.50262	2371	30.292594	30.083231	30.513081
2370	30.302863	30.117412	30.503468	2370	30.293098	30.083818	30.513504
2369	30.303349	30.117607	30.504212	2369	30.293602	30.084344	30.514134
2368	30.303836	30.118265	30.504591	2368	30.294106	30.084888	30.514808
2367	30.304322	30.118806	30.505001	2367	30.29461	30.085432	30.515917
2366	30.304809	30.119311	30.505567	2366	30.295113	30.085827	30.51681
2365	30.305295	30.119653	30.506287	2365	30.295617	30.086064	30.517625
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2363	30.306268	30.120121	30.507386	2363	30.296625	30.086526	30.518644
2362	30.306755	30.120545	30.508241	2362	30.297129	30.086753	30.519412
2361	30.307241	30.120926	30.508804	2361	30.297633	30.08698	30.520109
2360	30.307728	30.121105	30.50933	2360	30.298137	30.087278	30.520437
2359	30.308214	30.121413	30.509848	2359	30.298641	30.087874	30.521398
2358	30.308701	30.121648	30.510386	2358	30.299145	30.088442	30.522062
2357	30.309187	30.122081	30.510813	2357	30.299648	30.089094	30.522575
2356	30.309674	30.122412	30.511481	2356	30.300152	30.089452	30.523161
2355	30.31016	30.122736	30.511844	2355	30.300656	30.089787	30.523744

2354	30.310647	30.123049	30.512978	2354	30.30116	30.090122	30.52403
2353	30.311133	30.123357	30.513553	2353	30.301664	30.0907	30.52462
2352	30.31162	30.123719	30.51457	2352	30.302168	30.091198	30.525391
2351	30.312106	30.124165	30.515113	2351	30.302672	30.09144	30.526092
2350	30.312592	30.124525	30.515537	2350	30.303176	30.091938	30.526424
2349	30.313079	30.124729	30.51643	2349	30.303679	30.09235	30.527022
2348	30.313565	30.124963	30.51738	2348	30.304183	30.092547	30.527702
2347	30.314052	30.125168	30.518348	2347	30.304687	30.092818	30.528219
2346	30.314538	30.125673	30.519011	2346	30.305191	30.093248	30.528813
2345	30.315025	30.125978	30.519599	2345	30.305695	30.09371	30.529417
2344	30.315518	30.126517	30.520079	2344	30.306186	30.094666	30.529735
2343	30.316012	30.127198	30.520559	2343	30.306677	30.094975	30.530083
2342	30.316506	30.127661	30.521044	2342	30.307168	30.095546	30.530427
2341	30.316999	30.128317	30.521556	2341	30.307658	30.096314	30.530769
2340	30.317493	30.129088	30.522035	2340	30.308149	30.097043	30.531142
2339	30.317986	30.129822	30.52249	2339	30.30864	30.097774	30.531459
2338	30.31848	30.130419	30.522887	2338	30.309131	30.098504	30.531784
2337	30.318974	30.130874	30.523064	2337	30.309622	30.099092	30.53197
2336	30.319467	30.131282	30.523307	2336	30.310113	30.099642	30.532182
2335	30.319961	30.131651	30.523597	2335	30.310604	30.100415	30.532676
2334	30.320455	30.132242	30.52419	2334	30.311094	30.10121	30.533179
2333	30.320948	30.133004	30.524632	2333	30.311585	30.101858	30.533678
2332	30.321442	30.134184	30.524966	2332	30.312076	30.102369	30.534119
2331	30.321935	30.13467	30.525579	2331	30.312567	30.102875	30.53421
2330	30.322429	30.135142	30.526532	2330	30.313058	30.10337	30.535166
2329	30.322923	30.135614	30.526765	2329	30.313549	30.103864	30.535376
2328	30.323416	30.136069	30.526875	2328	30.314039	30.10437	30.5358
2327	30.32391	30.136507	30.527232	2327	30.31453	30.105074	30.535955
2326	30.324403	30.136901	30.527691	2326	30.315021	30.106224	30.536114
2325	30.324897	30.137199	30.528263	2325	30.315512	30.106825	30.536274
2324	30.325391	30.137651	30.528672	2324	30.316003	30.107712	30.536781
2323	30.325884	30.138091	30.529114	2323	30.316494	30.108269	30.537526
2322	30.326378	30.138823	30.529191	2322	30.316985	30.109059	30.538112
2321	30.326871	30.139045	30.529315	2321	30.317475	30.10985	30.538682
2320	30.327365	30.139348	30.529515	2320	30.317966	30.110279	30.539521
2319	30.327859	30.139771	30.530054	2319	30.318457	30.111105	30.540388
2318	30.328352	30.140232	30.530762	2318	30.318948	30.112137	30.540646
2317	30.328846	30.14082	30.531082	2317	30.319439	30.11267	30.541168
2316	30.329339	30.141019	30.531402	2316	30.31993	30.113319	30.541849
2315	30.329833	30.141189	30.531933	2315	30.320421	30.114222	30.542636
2314	30.330327	30.1416	30.532497	2314	30.320911	30.114505	30.543037
2313	30.33082	30.141757	30.533015	2313	30.321402	30.114784	30.54358
2312	30.331314	30.142024	30.533329	2312	30.321893	30.115323	30.544161
2311	30.331807	30.142519	30.533462	2311	30.322384	30.11586	30.544655
2310	30.332301	30.143305	30.533839	2310	30.322875	30.116386	30.544866
2309	30.332795	30.14387	30.534398	2309	30.323366	30.11748	30.544909
2308	30.333288	30.144151	30.534522	2308	30.323856	30.11765	30.545257
2307	30.333782	30.144453	30.535002	2307	30.324347	30.118305	30.546178
2306	30.334275	30.144709	30.535627	2306	30.324838	30.118942	30.546772
2305	30.334769	30.145075	30.535743	2305	30.325329	30.119602	30.547367
2304	30.335263	30.145726	30.536181	2304	30.32582	30.119857	30.54789
2303	30.335756	30.146399	30.536467	2303	30.326311	30.120358	30.548411
2302	30.33625	30.146709	30.537024	2302	30.326802	30.120845	30.548552
2301	30.336744	30.147236	30.537578	2301	30.327292	30.121255	30.549013
2300	30.337237	30.147703	30.537944	2300	30.327783	30.121779	30.549653
2299	30.337731	30.148128	30.538455	2299	30.328274	30.12261	30.550293
2298	30.338224	30.148715	30.539254	2298	30.328765	30.123021	30.550961
2297	30.338718	30.149344	30.540255	2297	30.329256	30.123442	30.551634
2296	30.339212	30.149864	30.540912	2296	30.329747	30.123767	30.552284
2295	30.339705	30.150235	30.541555	2295	30.330238	30.124141	30.552785
2294	30.340199	30.150539	30.541874	2294	30.330728	30.124339	30.55317
2293	30.340692	30.150756	30.542385	2293	30.331219	30.125031	30.553664
2292	30.341186	30.151137	30.542921	2292	30.33171	30.12534	30.55416
2291	30.34168	30.151517	30.543216	2291	30.332201	30.125646	30.554657
2290	30.342173	30.151955	30.543903	2290	30.332692	30.126591	30.555153
2289	30.342667	30.152294	30.544729	2289	30.333183	30.126732	30.555439
2288	30.34316	30.152534	30.545252	2288	30.333673	30.127361	30.555733
2287	30.343654	30.153014	30.545754	2287	30.334164	30.127729	30.556017
2286	30.344148	30.153324	30.546385	2286	30.334655	30.127861	30.556287
2285	30.344641	30.153881	30.546716	2285	30.335146	30.12811	30.556947
2284	30.345135	30.154489	30.546909	2284	30.335637	30.128359	30.557583
2283	30.345628	30.155078	30.54755	2283	30.336128	30.128626	30.557765
2282	30.346122	30.155667	30.54795	2282	30.336619	30.129557	30.558039
2281	30.346616	30.156235	30.548599	2281	30.337109	30.129797	30.558572
2280	30.347109	30.156716	30.549255	2280	30.3376	30.13042	30.55912
2279	30.347603	30.157105	30.550073	2279	30.338091	30.13133	30.559432
2278	30.348096	30.157376	30.550416	2278	30.338582	30.131861	30.559685
2277	30.34859	30.157699	30.550761	2277	30.339073	30.132146	30.559937
2276	30.349084	30.157934	30.55107	2276	30.339564	30.132981	30.560316

2275	30.349577	30.158393	30.551464	2275	30.340055	30.133413	30.561505
2274	30.350071	30.15874	30.55178	2274	30.340545	30.133715	30.561958
2273	30.350564	30.159041	30.552227	2273	30.341036	30.134813	30.562222
2272	30.351058	30.159346	30.552549	2272	30.341527	30.135108	30.562857
2271	30.351552	30.159556	30.553285	2271	30.342018	30.135251	30.563219
2270	30.352045	30.159973	30.554035	2270	30.342509	30.135395	30.563447
2269	30.352539	30.160315	30.554576	2269	30.343	30.135624	30.564046
2268	30.353033	30.160778	30.555174	2268	30.34349	30.13591	30.564755
2267	30.353526	30.161289	30.555668	2267	30.343981	30.136191	30.565091
2266	30.35402	30.161685	30.556195	2266	30.344472	30.136359	30.565392
2265	30.354513	30.162207	30.556709	2265	30.344963	30.136763	30.566149
2264	30.355007	30.162638	30.557124	2264	30.345454	30.137216	30.567019
2263	30.355501	30.163191	30.557818	2263	30.345945	30.137613	30.568291
2262	30.355994	30.163661	30.558735	2262	30.346436	30.13799	30.569019
2261	30.356488	30.164193	30.559332	2261	30.346926	30.13802	30.569352
2260	30.356981	30.164597	30.559988	2260	30.347417	30.138455	30.569916
2259	30.357475	30.165013	30.560843	2259	30.347908	30.138712	30.570402
2258	30.357969	30.165502	30.561536	2258	30.348399	30.139075	30.570994
2257	30.358462	30.165928	30.562153	2257	30.34889	30.139486	30.571639
2256	30.358956	30.166424	30.562479	2256	30.349381	30.139641	30.571976
2255	30.359449	30.16692	30.563432	2255	30.349872	30.140077	30.572308
2254	30.359943	30.167271	30.564226	2254	30.350362	30.140753	30.57272
2253	30.360437	30.167431	30.564868	2253	30.350853	30.141025	30.573271
2252	30.36093	30.167625	30.565448	2252	30.351344	30.141193	30.573695
2251	30.361424	30.168025	30.565942	2251	30.351835	30.141829	30.574376
2250	30.361917	30.16859	30.566321	2250	30.352326	30.142266	30.575168
2249	30.362411	30.169189	30.566709	2249	30.352817	30.142445	30.576351
2248	30.362905	30.169543	30.567169	2248	30.353307	30.142474	30.577616
2247	30.363398	30.169808	30.567974	2247	30.353798	30.142503	30.577846
2246	30.363892	30.170349	30.568443	2246	30.354289	30.143004	30.578366
2245	30.364385	30.17094	30.568817	2245	30.35478	30.143373	30.578643
2244	30.364879	30.171147	30.569191	2244	30.355271	30.14368	30.578919
2243	30.365373	30.171201	30.569615	2243	30.355762	30.143801	30.579203
2242	30.365866	30.171464	30.570345	2242	30.356253	30.14416	30.579557
2241	30.36636	30.172013	30.570823	2241	30.356743	30.144566	30.579767
2240	30.366853	30.172269	30.571325	2240	30.357234	30.144861	30.580676
2239	30.367347	30.172629	30.571972	2239	30.357725	30.14499	30.581964
2238	30.367841	30.172859	30.572418	2238	30.358216	30.145117	30.582742
2237	30.368334	30.173002	30.57304	2237	30.358707	30.145249	30.58343
2236	30.368828	30.17314	30.574408	2236	30.359198	30.145722	30.584214
2235	30.369321	30.173503	30.575127	2235	30.359689	30.146245	30.584566
2234	30.369815	30.17367	30.57541	2234	30.360179	30.146554	30.584704
2233	30.370309	30.173792	30.575897	2233	30.36067	30.147129	30.585397
2232	30.370802	30.174327	30.576811	2232	30.361161	30.147577	30.586632
2231	30.371296	30.174871	30.577873	2231	30.361652	30.148167	30.587865
2230	30.37179	30.175375	30.578481	2230	30.362143	30.148718	30.589092
2229	30.372283	30.175867	30.579736	2229	30.362634	30.149304	30.589933
2228	30.372777	30.176155	30.580552	2228	30.363124	30.149938	30.590402
2227	30.37327	30.176508	30.581201	2227	30.363615	30.150415	30.59085
2226	30.373764	30.176872	30.581835	2226	30.364106	30.150754	30.591476
2225	30.374258	30.177433	30.582416	2225	30.364597	30.151407	30.592927
2224	30.374751	30.17783	30.582847	2224	30.365088	30.151846	30.594525
2223	30.375245	30.178136	30.583606	2223	30.365579	30.152019	30.595583
2222	30.375738	30.178351	30.583908	2222	30.36607	30.152196	30.596213
2221	30.376232	30.178562	30.584262	2221	30.36656	30.152442	30.597547
2220	30.376726	30.17898	30.585119	2220	30.367051	30.152836	30.598415
2219	30.377226	30.179248	30.585615	2219	30.367531	30.153429	30.598553
2218	30.377727	30.179715	30.586239	2218	30.368011	30.153664	30.598707
2217	30.378227	30.18023	30.58695	2217	30.368491	30.154247	30.599149
2216	30.378727	30.180714	30.587669	2216	30.36897	30.154676	30.599559
2215	30.379228	30.181198	30.588241	2215	30.36945	30.154941	30.600148
2214	30.379728	30.181694	30.588472	2214	30.36993	30.155353	30.600469
2213	30.380229	30.182217	30.588993	2213	30.37041	30.156043	30.600834
2212	30.380729	30.182699	30.589727	2212	30.370889	30.156827	30.60106
2211	30.38123	30.183182	30.590549	2211	30.371369	30.157228	30.601682
2210	30.38173	30.183684	30.591231	2210	30.371849	30.157513	30.602048
2209	30.382231	30.184419	30.591924	2209	30.372329	30.157906	30.602394
2208	30.382731	30.18539	30.592723	2208	30.372808	30.158453	30.602796
2207	30.383232	30.186205	30.593349	2207	30.373288	30.158764	30.603326
2206	30.383732	30.18707	30.59423	2206	30.373768	30.159165	30.603815
2205	30.384233	30.187247	30.595159	2205	30.374248	30.159631	30.604246
2204	30.384733	30.187444	30.595909	2204	30.374728	30.160205	30.604614
2203	30.385234	30.187639	30.59654	2203	30.375207	30.160801	30.60487
2202	30.385734	30.187806	30.597389	2202	30.375687	30.161545	30.605126
2201	30.386235	30.188026	30.597459	2201	30.376167	30.161933	30.605943
2200	30.386735	30.188463	30.598201	2200	30.376647	30.162498	30.606238
2199	30.387236	30.188713	30.598606	2199	30.377126	30.163399	30.606508
2198	30.387736	30.188899	30.598824	2198	30.377606	30.163918	30.607105
2197	30.388237	30.189085	30.599842	2197	30.378086	30.164574	30.607567

2196	30.388737	30.189583	30.600525	2196	30.378566	30.164925	30.607814
2195	30.389238	30.190592	30.600913	2195	30.379045	30.165287	30.608061
2194	30.389738	30.191376	30.601638	2194	30.379525	30.165504	30.608545
2193	30.390238	30.192176	30.601962	2193	30.380005	30.165938	30.609353
2192	30.390739	30.192632	30.602309	2192	30.380485	30.166034	30.60986
2191	30.391239	30.193516	30.602619	2191	30.380965	30.166641	30.610454
2190	30.39174	30.195099	30.603336	2190	30.381444	30.167374	30.610906
2189	30.39224	30.195573	30.604087	2189	30.381924	30.168107	30.611862
2188	30.392741	30.195789	30.604819	2188	30.382404	30.168839	30.612203
2187	30.393241	30.195902	30.605233	2187	30.382884	30.169572	30.612544
2186	30.393742	30.196251	30.605701	2186	30.383363	30.170118	30.612896
2185	30.394242	30.196656	30.606039	2185	30.383843	30.170681	30.613647
2184	30.394743	30.197436	30.6067	2184	30.384323	30.171152	30.613986
2183	30.395243	30.197861	30.607031	2183	30.384803	30.171955	30.614389
2182	30.395744	30.198504	30.608166	2182	30.385282	30.172729	30.615251
2181	30.396244	30.198998	30.608947	2181	30.385762	30.173191	30.616103
2180	30.396745	30.19919	30.609685	2180	30.386242	30.173592	30.616246
2179	30.397245	30.199465	30.610181	2179	30.386722	30.173981	30.61707
2178	30.397746	30.200302	30.610677	2178	30.387201	30.174309	30.618096
2177	30.398246	30.200779	30.611095	2177	30.387681	30.174773	30.61868
2176	30.398747	30.200896	30.611386	2176	30.388161	30.175457	30.618998
2175	30.399247	30.20166	30.611931	2175	30.388641	30.175798	30.619271
2174	30.399748	30.202201	30.612262	2174	30.389121	30.176308	30.619553
2173	30.400248	30.203039	30.612695	2173	30.3896	30.176829	30.620009
2172	30.400749	30.203139	30.612967	2172	30.39008	30.176996	30.620584
2171	30.401249	30.203184	30.613622	2171	30.39056	30.177254	30.620828
2170	30.40175	30.203487	30.614341	2170	30.39104	30.177564	30.621202
2169	30.40225	30.203893	30.614896	2169	30.391519	30.177877	30.621858
2168	30.40275	30.204514	30.615578	2168	30.391999	30.178193	30.622548
2167	30.403251	30.205065	30.61616	2167	30.392479	30.178505	30.622869
2166	30.403751	30.205524	30.616667	2166	30.392959	30.178596	30.623384
2165	30.404252	30.205886	30.617188	2165	30.393438	30.179025	30.623937
2164	30.404752	30.206346	30.617787	2164	30.393918	30.179214	30.623966
2163	30.405253	30.206593	30.618507	2163	30.394398	30.179872	30.624023
2162	30.405753	30.206952	30.618845	2162	30.394878	30.180645	30.624869
2161	30.406254	30.207603	30.619307	2161	30.395358	30.181495	30.625074
2160	30.406754	30.20845	30.619867	2160	30.395837	30.18174	30.625546
2159	30.407255	30.208866	30.6204	2159	30.396317	30.181972	30.625691
2158	30.407755	30.209397	30.620842	2158	30.396797	30.182224	30.625837
2157	30.408256	30.209945	30.621319	2157	30.397277	30.182618	30.625988
2156	30.408756	30.210462	30.621885	2156	30.397756	30.183003	30.627052
2155	30.409257	30.211232	30.62235	2155	30.398236	30.183428	30.627273
2154	30.409757	30.211524	30.622873	2154	30.398716	30.183786	30.628259
2153	30.410258	30.211927	30.623568	2153	30.399196	30.184194	30.628341
2152	30.410758	30.212325	30.624277	2152	30.399675	30.184578	30.629762
2151	30.411259	30.212591	30.624852	2151	30.400155	30.184968	30.630035
2150	30.411759	30.213203	30.625104	2150	30.400635	30.185352	30.630523
2149	30.41226	30.213661	30.625494	2149	30.401115	30.185627	30.631372
2148	30.41276	30.214186	30.625945	2148	30.401594	30.185827	30.632196
2147	30.413261	30.214457	30.626507	2147	30.402074	30.186538	30.633291
2146	30.413761	30.214767	30.626913	2146	30.402554	30.186941	30.634353
2145	30.414261	30.214918	30.627426	2145	30.403034	30.18783	30.635413
2144	30.414762	30.215339	30.628188	2144	30.403514	30.188216	30.635982
2143	30.415262	30.21578	30.628918	2143	30.403993	30.188365	30.636915
2142	30.415763	30.216123	30.629663	2142	30.404473	30.188524	30.637532
2141	30.416263	30.21674	30.630357	2141	30.404953	30.18898	30.638026
2140	30.416764	30.217388	30.631017	2140	30.405433	30.189424	30.638709
2139	30.417264	30.217806	30.631346	2139	30.405912	30.189708	30.639821
2138	30.417765	30.21811	30.632218	2138	30.406392	30.190148	30.640461
2137	30.418265	30.218375	30.633121	2137	30.406872	30.190645	30.641019
2136	30.418766	30.218686	30.63403	2136	30.407352	30.190917	30.641917
2135	30.419266	30.218994	30.634805	2135	30.407831	30.19123	30.642468
2134	30.419767	30.219463	30.635868	2134	30.408311	30.191531	30.643186
2133	30.420267	30.219715	30.636896	2133	30.408791	30.191828	30.644077
2132	30.420768	30.220095	30.637642	2132	30.409271	30.192408	30.644649
2131	30.421268	30.220472	30.638365	2131	30.409751	30.192801	30.645835
2130	30.421769	30.221203	30.638965	2130	30.41023	30.192997	30.646204
2129	30.422269	30.221625	30.639622	2129	30.41071	30.19321	30.646924
2128	30.42277	30.222135	30.640472	2128	30.41119	30.193493	30.648131
2127	30.42327	30.222607	30.641198	2127	30.41167	30.193938	30.648783
2126	30.423771	30.22297	30.641957	2126	30.412149	30.194047	30.649475
2125	30.424271	30.223415	30.642617	2125	30.412629	30.194642	30.650243
2124	30.424772	30.22359	30.643356	2124	30.413109	30.194816	30.651157
2123	30.425272	30.223878	30.644032	2123	30.413589	30.195179	30.6515
2122	30.425772	30.224264	30.644729	2122	30.414068	30.195765	30.651976
2121	30.426273	30.22463	30.645428	2121	30.414548	30.195982	30.652714
2120	30.426773	30.225059	30.646135	2120	30.415028	30.196197	30.653341
2119	30.427274	30.225389	30.64678				
2118	30.427774	30.225801	30.647565				

2117	30.428275	30.226419	30.648564
2116	30.428775	30.226841	30.649942
2115	30.429276	30.227328	30.650534
2114	30.429776	30.228093	30.651079
2113	30.430277	30.228551	30.652385
2112	30.430777	30.228718	30.653091
2111	30.431278	30.228811	30.653553
2110	30.431778	30.228998	30.654176
2109	30.432279	30.229158	30.654854
2108	30.432779	30.229297	30.655668
2107	30.43328	30.229446	30.656518
2106	30.43378	30.229823	30.657573
2105	30.434281	30.229942	30.658198
2104	30.434781	30.230297	30.658732
2103	30.435282	30.230675	30.659571
2102	30.435782	30.231046	30.660085
2101	30.436283	30.231334	30.661041
2100	30.436783	30.231842	30.66199
2099	30.437283	30.232228	30.663019
2098	30.437784	30.232502	30.663342
2097	30.438284	30.232651	30.664397
2096	30.438785	30.233279	30.6649
2095	30.439285	30.233774	30.665786
2094	30.439813	30.234072	30.66681
2093	30.44034	30.23471	30.667171
2092	30.440868	30.235442	30.668199
2091	30.441396	30.23595	30.668799
2090	30.441923	30.236417	30.669614
2089	30.442451	30.236922	30.670209
2088	30.442978	30.237587	30.670632
2087	30.443506	30.238179	30.671054
2086	30.444033	30.238554	30.671509
2085	30.444561	30.239099	30.67199
2084	30.445088	30.239553	30.672405
2083	30.445616	30.239836	30.672823
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2081	30.446671	30.24052	30.673812
2080	30.447198	30.241292	30.674617
2079	30.447726	30.241757	30.674874
2078	30.448254	30.241957	30.675435
2077	30.448781	30.242751	30.675915
2076	30.449309	30.243219	30.676345
2075	30.449836	30.243579	30.676628
2074	30.450364	30.243868	30.677083
2073	30.450891	30.244482	30.677651
2072	30.451419	30.244963	30.678366
2071	30.451946	30.245518	30.678938
2070	30.452474	30.245898	30.679507
2069	30.453001	30.246164	30.680134
2068	30.453529	30.246471	30.68076
2067	30.454056	30.246781	30.681463
2066	30.454584	30.247069	30.682645
2065	30.455112	30.247419	30.683449
2064	30.455639	30.247751	30.684228
2063	30.456167	30.248129	30.684798
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2061	30.457222	30.249339	30.686859
2060	30.457749	30.249741	30.687212
2059	30.458277	30.250025	30.688139
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2057	30.459332	30.250487	30.689828
2056	30.459859	30.250796	30.6903
2055	30.460387	30.251304	30.691229
2054	30.460914	30.252007	30.691926
2053	30.461442	30.252273	30.692468
2052	30.46197	30.252688	30.693009
2051	30.462497	30.252859	30.693245
2050	30.463025	30.25303	30.69356
2049	30.463552	30.253343	30.69373
2048	30.46408	30.253936	30.694037
2047	30.464607	30.254443	30.694403
2046	30.465135	30.254728	30.695028
2045	30.465662	30.255192	30.695985
2044	30.46619	30.256301	30.696535
2043	30.466717	30.256957	30.697576
2042	30.467245	30.25726	30.698144
2041	30.467772	30.257565	30.698423
2040	30.4683	30.25864	30.698986
2039	30.468828	30.259325	30.699842

2038	30.469355	30.259453	30.700662
2037	30.469883	30.260032	30.701167
2036	30.47041	30.260706	30.702436
2035	30.470938	30.261117	30.702982
2034	30.471465	30.261761	30.704155
2033	30.471993	30.262195	30.70446
2032	30.47252	30.262485	30.704747
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2028	30.47463	30.264583	30.707808
2027	30.475158	30.265294	30.708723
2026	30.475685	30.265794	30.709706
2025	30.476213	30.266233	30.711055
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2023	30.477268	30.267138	30.713002
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2021	30.478323	30.26801	30.714363
2020	30.478851	30.26817	30.715579
2019	30.479378	30.268315	30.716531
2018	30.479906	30.26846	30.717689
2017	30.480433	30.268844	30.718279
2016	30.480961	30.26938	30.71934
2015	30.481488	30.26999	30.720082
2014	30.482016	30.270283	30.720867
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2012	30.483071	30.270816	30.722834
2011	30.483599	30.271072	30.723059
2010	30.484126	30.271366	30.723288
2009	30.484654	30.27182	30.72364
2008	30.485181	30.272098	30.724029
2007	30.485709	30.272277	30.724563
2006	30.486236	30.27299	30.724937
2005	30.486764	30.273241	30.725949
2004	30.487291	30.273563	30.726624
2003	30.487819	30.27375	30.727765
2002	30.488346	30.273992	30.728744
2001	30.488874	30.27408	30.729103
2000	30.489401	30.27457	30.729822
1999	30.489929	30.275154	30.730601
1998	30.490457	30.27547	30.731185
1997	30.490984	30.275696	30.731969
1996	30.491512	30.276035	30.733017
1995	30.492039	30.276168	30.734446
1994	30.492567	30.276612	30.735396
1993	30.493094	30.276908	30.736564
1992	30.493622	30.277325	30.737432
1991	30.494149	30.277663	30.738491
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1989	30.495204	30.277927	30.740831
1988	30.495732	30.278181	30.741426
1987	30.496259	30.278458	30.742282
1986	30.496787	30.27903	30.743239
1985	30.497315	30.279401	30.744134
1984	30.497842	30.279481	30.745331
1983	30.49837	30.27986	30.74652
1982	30.498897	30.280244	30.747735
1981	30.499425	30.280771	30.748793
1980	30.499952	30.28113	30.749858
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1978	30.501007	30.281674	30.752396
1977	30.501535	30.281878	30.753725
1976	30.502062	30.282089	30.754505
1975	30.50259	30.282327	30.755435
1974	30.503117	30.282566	30.756164
1973	30.503645	30.282962	30.757545
1972	30.504173	30.283211	30.758548
1971	30.5047	30.283545	30.759463
1970	30.505228	30.283778	30.760279
1969	30.505753	30.284503	30.760948
1968	30.506278	30.285348	30.76121
1967	30.506803	30.285701	30.761433
1966	30.507328	30.286293	30.761656
1965	30.507853	30.286666	30.762385
1964	30.508378	30.28743	30.763411
1963	30.508903	30.287824	30.763769
1962	30.509428	30.288609	30.763909
1961	30.509953	30.289184	30.76411
1960	30.510478	30.289831	30.764525

1959	30.511004	30.290281	30.764587
1958	30.511529	30.290682	30.765275
1957	30.512054	30.290825	30.765389
1956	30.512579	30.291264	30.765555
1955	30.513104	30.291498	30.76642
1954	30.513629	30.291609	30.76736
1953	30.514154	30.292066	30.767546
1952	30.514679	30.292798	30.767743
1951	30.515204	30.293597	30.767988
1950	30.515729	30.29426	30.768542
1949	30.516254	30.294844	30.769198
1948	30.51678	30.295075	30.769919
1947	30.517305	30.295583	30.770643
1946	30.51783	30.296148	30.771311
1945	30.518355	30.296536	30.772085
1944	30.51888	30.296954	30.772966
1943	30.519405	30.297763	30.773515
1942	30.51993	30.298378	30.774004
1941	30.520455	30.29868	30.774497
1940	30.52098	30.299056	30.774907
1939	30.521505	30.29942	30.775346
1938	30.52203	30.299806	30.776003
1937	30.522555	30.300065	30.77634
1936	30.523081	30.300341	30.777534
1935	30.523606	30.301016	30.778633
1934	30.524131	30.301526	30.779051
1933	30.524656	30.301922	30.779426
1932	30.525181	30.302238	30.779817
1931	30.525706	30.302969	30.780668
1930	30.526231	30.303734	30.781111
1929	30.526756	30.304257	30.782302
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1927	30.527806	30.305204	30.783559
1926	30.528331	30.305438	30.784364
1925	30.528857	30.305726	30.78499
1924	30.529382	30.306397	30.785923
1923	30.529907	30.306614	30.786397
1922	30.530432	30.307028	30.786931
1921	30.530957	30.307448	30.787407
1920	30.531482	30.307939	30.787813
1919	30.532007	30.308824	30.788161
1918	30.532532	30.309214	30.788608
1917	30.533057	30.309335	30.78943
1916	30.533582	30.309455	30.790082
1915	30.534107	30.309632	30.791106
1914	30.534633	30.31026	30.79185
1913	30.535158	30.310843	30.792251
1912	30.535683	30.310981	30.792632
1911	30.536208	30.311347	30.792934
1910	30.536733	30.312142	30.793458
1909	30.537258	30.312646	30.793868
1908	30.537783	30.312946	30.794459
1907	30.538308	30.31311	30.79515
1906	30.538833	30.313287	30.79588
1905	30.539358	30.313488	30.796622
1904	30.539883	30.314343	30.797356
1903	30.540408	30.314503	30.79811
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1901	30.541459	30.315385	30.799546
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1898	30.543034	30.315899	30.801776
1897	30.543559	30.316058	30.802591
1896	30.544084	30.316216	30.803145
1895	30.544609	30.316484	30.803784
1894	30.545134	30.317192	30.804219
1893	30.545659	30.317813	30.804654
1892	30.546184	30.318108	30.805149
1891	30.54671	30.318867	30.806207
1890	30.547235	30.319103	30.80675
1889	30.54776	30.319246	30.807145
1888	30.548285	30.319719	30.807782
1887	30.54881	30.320123	30.809138
1886	30.549335	30.32027	30.809778
1885	30.54986	30.320469	30.810165
1884	30.550385	30.320867	30.811179
1883	30.55091	30.321224	30.812519
1882	30.551435	30.321624	30.81306
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1878	30.553536	30.323064	30.816273
1877	30.554061	30.323226	30.816842
1876	30.554586	30.323447	30.817213
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1873	30.556161	30.324704	30.820099
1872	30.556686	30.325166	30.820434
1871	30.557211	30.325699	30.821499
1870	30.557736	30.326082	30.822292
1869	30.558261	30.326623	30.823088
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1863	30.561412	30.329026	30.827869
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1861	30.562462	30.329364	30.828838
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1824	30.581671	30.345492	30.854534
1823	30.582185	30.346007	30.855211
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1821	30.583215	30.346898	30.856192
1820	30.583729	30.347337	30.856355
1819	30.584244	30.347681	30.856618
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1794	30.597109	30.35754	30.872085
1793	30.597624	30.357898	30.872814
1792	30.598139	30.358266	30.873075
1791	30.598653	30.358716	30.873423
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1787	30.600712	30.360217	30.875907
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1783	30.60277	30.362194	30.878823
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1775	30.606887	30.366069	30.883274
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1762	30.613577	30.37096	30.893556
1761	30.614092	30.371657	30.894504
1760	30.614607	30.372098	30.894992
1759	30.615121	30.372311	30.896369
1758	30.615636	30.372894	30.896864
1757	30.616151	30.373232	30.898384
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1753	30.618209	30.37537	30.901854
1752	30.618724	30.37567	30.902369
1751	30.619238	30.376043	30.903002
1750	30.619753	30.376691	30.903645
1749	30.620268	30.376758	30.904334
1748	30.620782	30.376975	30.905142
1747	30.621297	30.377227	30.906445
1746	30.621811	30.377848	30.907335
1745	30.622326	30.37821	30.908088
1744	30.622841	30.378398	30.909427
1743	30.623355	30.378657	30.910151
1742	30.62387	30.378787	30.911392
1741	30.624385	30.379104	30.912095
1740	30.624899	30.379368	30.912747
1739	30.625414	30.379675	30.913373
1738	30.625928	30.380215	30.914039
1737	30.626443	30.38069	30.914716
1736	30.626958	30.380843	30.915996
1735	30.627472	30.381089	30.91762
1734	30.627987	30.381373	30.919125
1733	30.628502	30.381493	30.920707
1732	30.629016	30.381613	30.922386
1731	30.629531	30.382019	30.923585
1730	30.630045	30.382499	30.924571
1729	30.63056	30.382961	30.925047
1728	30.631075	30.383461	30.925794
1727	30.631589	30.383831	30.926325
1726	30.632104	30.384101	30.927131
1725	30.632619	30.384323	30.927886
1724	30.633133	30.385098	30.92921
1723	30.633648	30.385678	30.929829

1722	30.634163	30.386189	30.930761
1721	30.634677	30.386517	30.932539
1720	30.635192	30.386688	30.932991
1719	30.635713	30.386858	30.933471
1718	30.636235	30.387286	30.933874
1717	30.636757	30.388055	30.934332
1716	30.637278	30.389017	30.934946
1715	30.6378	30.389766	30.935324
1714	30.638321	30.390509	30.935588
1713	30.638843	30.390708	30.936261
1712	30.639364	30.390908	30.936694
1711	30.639886	30.391367	30.937082
1710	30.640408	30.392536	30.937285
1709	30.640929	30.39344	30.937858
1708	30.641451	30.393834	30.938227
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1706	30.642494	30.39441	30.939023
1705	30.643016	30.394644	30.939411
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1698	30.646667	30.398356	30.943659
1697	30.647188	30.398556	30.943777
1696	30.64771	30.398772	30.944771
1695	30.648231	30.398987	30.94518
1694	30.648753	30.399469	30.946217
1693	30.649275	30.400097	30.947109
1692	30.649796	30.400695	30.947623
1691	30.650318	30.401129	30.948022
1690	30.650839	30.401563	30.948084
1689	30.651361	30.401956	30.948517
1688	30.651883	30.402338	30.949406
1687	30.652404	30.402749	30.94991
1686	30.652926	30.403159	30.950606
1685	30.653447	30.403615	30.951012
1684	30.653969	30.404225	30.951308
1683	30.654491	30.404532	30.951537
1682	30.655012	30.405522	30.951859
1681	30.655534	30.406647	30.952578
1680	30.656055	30.406841	30.95395
1679	30.656577	30.406866	30.954491
1678	30.657099	30.40718	30.955176
1677	30.65762	30.407842	30.956348
1676	30.658142	30.408546	30.956638
1675	30.658663	30.409156	30.956927
1674	30.659185	30.409748	30.957601
1673	30.659706	30.410117	30.958271
1672	30.660228	30.410808	30.958627
1671	30.66075	30.411568	30.959247
1670	30.661271	30.412161	30.959825
1669	30.661793	30.412609	30.960497
1668	30.662314	30.412948	30.961269
1667	30.662836	30.413328	30.96168
1666	30.663358	30.413823	30.962095
1665	30.663879	30.414261	30.962612
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1663	30.664922	30.414784	30.963853
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1661	30.665966	30.415615	30.96501
1660	30.666487	30.41597	30.965622
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1657	30.668052	30.41651	30.966647
1656	30.668573	30.416814	30.966901
1655	30.669095	30.417582	30.967981
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1652	30.67066	30.418325	30.969958
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1647	30.673268	30.420847	30.972573
1646	30.673789	30.421446	30.973337
1645	30.674311	30.421995	30.973753
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1641	30.676397	30.422958	30.976635
1640	30.676919	30.423393	30.97707
1639	30.67744	30.423735	30.977818
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1637	30.678484	30.424317	30.979361
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1633	30.68057	30.426094	30.982281
1632	30.681092	30.426417	30.983171
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1630	30.682135	30.427344	30.984266
1629	30.682656	30.427833	30.984816
1628	30.683178	30.428082	30.985402
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1626	30.684221	30.428962	30.987233
1625	30.684743	30.429165	30.987936
1624	30.685264	30.429381	30.98849
1623	30.685786	30.429573	30.989254
1622	30.686308	30.429763	30.990059
1621	30.686829	30.429954	30.991017
1620	30.687351	30.43029	30.991625
1619	30.687872	30.430591	30.992358
1618	30.688394	30.430764	30.993117
1617	30.688915	30.431097	30.993344
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1615	30.689959	30.432169	30.994636
1614	30.69048	30.43249	30.995284
1613	30.691002	30.433048	30.995956
1612	30.691523	30.433314	30.996729
1611	30.692045	30.433413	30.99729
1610	30.692567	30.433584	30.997842
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1608	30.69361	30.434047	30.998815
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1605	30.695175	30.435109	31.001303
1604	30.695696	30.435238	31.001753
1603	30.696218	30.435291	31.003097
1602	30.696739	30.435329	31.003965
1601	30.697261	30.435477	31.004974
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1596	30.699869	30.436411	31.008678
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1593	30.701418	30.438054	31.011039
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1573	30.711691	30.448634	31.020244
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1571	30.712718	30.449677	31.021237
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1569	30.713745	30.450592	31.022795
1568	30.714259	30.451077	31.024015
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1566	30.715286	30.452114	31.025638
1565	30.7158	30.452654	31.026219

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1559	30.718882	30.45518	31.028512
1558	30.719396	30.45577	31.029091
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1556	30.720423	30.456723	31.030001
1555	30.720937	30.457251	31.030569
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1550	30.723505	30.459429	31.035268
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1548	30.724532	30.460325	31.036211
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1546	30.725559	30.461253	31.037109
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1533	30.732237	30.465251	31.04465
1532	30.732751	30.46604	31.04526
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1521	30.738401	30.469896	31.055459
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1358	30.820914	30.527834	31.160307
1357	30.821417	30.528199	31.160873
1356	30.821919	30.528564	31.161495
1355	30.822422	30.528929	31.162131
1354	30.822925	30.529187	31.162863
1353	30.823428	30.529309	31.164124
1352	30.823931	30.529946	31.165328
1351	30.824433	30.530339	31.166056
1350	30.824936	30.530902	31.166637
1349	30.825439	30.531306	31.167072
1348	30.825942	30.531526	31.167903
1347	30.826445	30.531557	31.168526
1346	30.826948	30.53157	31.168993
1345	30.82745	30.531751	31.169181
1344	30.827956	30.531985	31.169702
1343	30.828461	30.53238	31.170294
1342	30.828966	30.532743	31.170911
1341	30.829471	30.5331	31.171541
1340	30.829976	30.533527	31.172223
1339	30.830481	30.533839	31.172721
1338	30.830986	30.534156	31.173837
1337	30.831491	30.534359	31.174665
1336	30.831997	30.534646	31.174889
1335	30.832502	30.535029	31.175125
1334	30.833007	30.535336	31.175631
1333	30.833512	30.535876	31.175807
1332	30.834017	30.536254	31.175886
1331	30.834522	30.53665	31.17644
1330	30.835027	30.537057	31.176705
1329	30.835533	30.537459	31.177816
1328	30.836038	30.537861	31.178392

1327	30.836543	30.538439	31.178671
1326	30.837048	30.538815	31.1788
1325	30.837553	30.539144	31.178938
1324	30.838058	30.539604	31.179904
1323	30.838563	30.539992	31.180336
1322	30.839068	30.540407	31.180716
1321	30.839574	30.540951	31.180985
1320	30.840079	30.541142	31.181016

Table S5. Eruption rates of each section in Ethiopia flood basalts.

Section	Eruption rate (km ³ /yr)			Reference
	Based on Chron length		Based on paleomagnetic directional groups (DGs)	
	Sahy et al. (2017)	Ogg (2020)		
Lima-Limo (C12r)	0.03	0.02	4.61–4.69	This study
Lima-Limo (C12n)	0.04	0.08	4.44–4.50	This study
Lima-Limo (C11r)	0.14	0.12	5.96–6.19	This study
Belessa (C11r–C11n.1n)	N/A	0.1–0.7	N/A	Eid et al. (2021)
Waja (C12n)	N/A	4	13	Eid et al. (2021)