

High injection rates counteract formation of far-reaching fluid migration pathways at The Geysers geothermal field

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Introduction

Tables S1-S4 compliment Table 2 and present the results of the correlation analysis between the injection rate, IN , and the degree of disordering of sources, ZZ and the three components of ZZ for the ZZ and its components delayed with respect to IN values from zero to 21 days, step one day. Table S1 contains the results for the injection phase F1, Tables S2 and S3 contain the results for the injection phase F2 and Table S3 contains the results for the injection phase F3. The results in Table S2 relate to the correlations with the injections into the injection well Pratig and the results in Table S3 relate to the correlations with the summed injections into Pratig and Pratig29 wells.

Delay [days]	ZZ		Δ_r		Δ_M		Δ_ϕ	
	Corr. coef.	p-value	Corr. coef.	p-value	Corr. coef.	p-value	Corr. coef.	p-value
0	0.623	2.5E-03	0.694	4.9E-04	0.205	3.7E-01	-0.280	2.2E-01
1	0.621	2.7E-03	0.688	5.7E-04	0.210	3.6E-01	-0.275	2.3E-01
2	0.618	2.9E-03	0.682	6.6E-04	0.214	3.5E-01	-0.270	2.4E-01
3	0.614	3.0E-03	0.676	7.8E-04	0.219	3.4E-01	-0.265	2.5E-01
4	0.611	3.3E-03	0.669	9.1E-04	0.223	3.3E-01	-0.260	2.6E-01
5	0.607	3.5E-03	0.662	1.1E-03	0.227	3.2E-01	-0.255	2.6E-01
6	0.603	3.8E-03	0.654	1.3E-03	0.231	3.1E-01	-0.248	2.8E-01
7	0.599	4.1E-03	0.648	1.5E-03	0.235	3.1E-01	-0.244	2.9E-01
8	0.594	4.5E-03	0.641	1.7E-03	0.239	3.0E-01	-0.240	2.9E-01
9	0.590	4.9E-03	0.634	2.0E-03	0.243	2.9E-01	-0.236	3.0E-01
10	0.586	5.3E-03	0.627	2.3E-03	0.247	2.8E-01	-0.233	3.1E-01
11	0.581	5.7E-03	0.621	2.7E-03	0.250	2.7E-01	-0.229	3.2E-01
12	0.577	6.2E-03	0.614	3.1E-03	0.254	2.7E-01	-0.226	3.2E-01
13	0.572	6.7E-03	0.607	3.5E-03	0.257	2.6E-01	-0.223	3.3E-01
14	0.568	7.2E-03	0.602	3.9E-03	0.263	2.5E-01	-0.223	3.3E-01
15	0.563	7.8E-03	0.595	4.4E-03	0.266	2.4E-01	-0.220	3.4E-01
16	0.559	8.4E-03	0.588	5.0E-03	0.270	2.4E-01	-0.216	3.5E-01
17	0.554	9.1E-03	0.581	5.7E-03	0.274	2.3E-01	-0.213	3.5E-01
18	0.550	9.8E-03	0.574	6.5E-03	0.279	2.2E-01	-0.209	3.6E-01
19	0.545	1.1E-02	0.567	7.4E-03	0.283	2.1E-01	-0.206	3.7E-01
20	0.542	1.1E-02	0.560	8.2E-03	0.288	2.1E-01	-0.201	3.8E-01
21	0.538	1.2E-02	0.553	9.3E-03	0.292	2.0E-01	-0.198	3.9E-01

Table S1. Results of the correlation analysis between the average injection rate, IN , and the degree of disordering of seismic sources, ZZ , and its components, Δ_r , Δ_M , Δ_ϕ for the phase F1. The correlation have been evaluated for ZZ , Δ_r , Δ_M , Δ_ϕ delayed from 0 to 21 days with respect to IN .

Delay [days]	ZZ		Δ_r		Δ_M		Δ_ϕ	
	Corr. coef.	p-value	Corr. coef.	p-value	Corr. coef.	p-value	Corr. coef.	p-value
0	0.756	2.2E-13	0.687	1.9E-10	0.408	6.7E-04	<i>0.493</i>	<i>3.4E-05</i>
1	0.759	1.5E-13	0.693	1.1E-10	0.409	6.6E-04	<i>0.488</i>	<i>4.1E-05</i>
2	0.761	1.2E-13	0.698	7.6E-11	0.409	6.5E-04	<i>0.482</i>	<i>5.1E-05</i>
3	0.762	1.1E-13	0.701	5.8E-11	0.407	6.9E-04	<i>0.481</i>	<i>5.4E-05</i>
4	0.762	1.1E-13	0.703	4.5E-11	0.407	7.1E-04	<i>0.481</i>	<i>5.3E-05</i>
5	0.764	9.0E-14	0.707	3.1E-11	0.407	7.0E-04	<i>0.478</i>	<i>6.1E-05</i>
6	0.765	7.4E-14	0.711	2.1E-11	0.407	6.8E-04	<i>0.475</i>	<i>6.9E-05</i>
7	0.767	6.0E-14	0.715	1.5E-11	0.408	6.7E-04	<i>0.472</i>	<i>7.6E-05</i>
8	0.768	5.0E-14	0.719	1.0E-11	0.408	6.7E-04	<i>0.467</i>	<i>9.3E-05</i>
9	0.770	4.2E-14	0.723	7.0E-12	0.408	6.8E-04	<i>0.456</i>	<i>1.4E-04</i>
10	0.771	3.6E-14	0.727	4.9E-12	0.407	6.8E-04	<i>0.454</i>	<i>1.5E-04</i>
11	0.772	3.1E-14	0.730	3.6E-12	0.408	6.8E-04	<i>0.447</i>	<i>1.9E-04</i>
12	0.773	2.8E-14	0.733	2.7E-12	0.409	6.5E-04	<i>0.441</i>	<i>2.5E-04</i>
13	0.774	2.5E-14	0.736	1.9E-12	0.409	6.5E-04	<i>0.444</i>	<i>2.2E-04</i>
14	0.775	2.2E-14	0.740	1.2E-12	0.407	6.9E-04	<i>0.440</i>	<i>2.6E-04</i>
15	0.776	2.0E-14	0.743	8.7E-13	0.407	6.9E-04	<i>0.435</i>	<i>3.0E-04</i>
16	0.777	1.8E-14	0.747	6.1E-13	0.407	7.0E-04	<i>0.430</i>	<i>3.6E-04</i>
17	0.777	1.6E-14	0.750	4.4E-13	0.407	7.0E-04	<i>0.427</i>	<i>3.9E-04</i>
18	0.778	1.5E-14	0.753	3.1E-13	0.407	7.0E-04	<i>0.422</i>	<i>4.7E-04</i>
19	0.778	1.5E-14	0.755	2.5E-13	0.406	7.2E-04	<i>0.417</i>	<i>5.5E-04</i>
20	0.778	1.4E-14	0.758	1.8E-13	0.406	7.2E-04	<i>0.410</i>	<i>6.9E-04</i>
21	0.778	1.4E-14	0.760	1.4E-13	0.407	6.8E-04	<i>0.406</i>	<i>8.0E-04</i>

Table S2. Results of the correlation analysis between the average injection rate into Prati9 well, $IN(9)$, and the degree of disordering of seismic sources, ZZ , and its components, Δ_r , Δ_M , Δ_ϕ for the phase F2. The correlation have been evaluated for ZZ , Δ_r , Δ_M , Δ_ϕ delayed from 0 to 21 days with respect to $IN(9)$. The results based on Spearman rank correlation are in italics.

Delay [days]	ZZ		Δ_r		Δ_M		Δ_ϕ	
	Corr. coef.	p-value	Corr. coef.	p-value	Corr. coef.	p-value	Corr. coef.	p-value
0	0.722	7.7E-12	0.663	1.3E-09	0.452	1.4E-04	<i>0.472</i>	<i>7.6E-05</i>
1	0.723	6.9E-12	0.667	9.9E-10	0.453	1.4E-04	<i>0.466</i>	<i>9.7E-05</i>
2	0.723	6.8E-12	0.668	8.6E-10	0.453	1.3E-04	<i>0.472</i>	<i>7.8E-05</i>
3	0.723	7.0E-12	0.670	7.8E-10	0.451	1.4E-04	<i>0.477</i>	<i>6.3E-05</i>
4	0.721	8.4E-12	0.669	8.0E-10	0.450	1.5E-04	<i>0.476</i>	<i>6.6E-05</i>
5	0.721	8.6E-12	0.671	7.1E-10	0.450	1.5E-04	<i>0.470</i>	<i>8.4E-05</i>
6	0.721	8.9E-12	0.672	6.5E-10	0.451	1.5E-04	<i>0.462</i>	<i>1.1E-04</i>
7	0.720	9.1E-12	0.673	5.9E-10	0.451	1.5E-04	<i>0.465</i>	<i>1.0E-04</i>
8	0.720	9.3E-12	0.675	5.3E-10	0.450	1.5E-04	<i>0.466</i>	<i>9.8E-05</i>
9	0.720	9.4E-12	0.676	4.7E-10	0.449	1.5E-04	<i>0.467</i>	<i>9.4E-05</i>
10	0.720	9.6E-12	0.677	4.2E-10	0.448	1.6E-04	<i>0.474</i>	<i>7.2E-05</i>
11	0.721	9.1E-12	0.679	3.7E-10	0.448	1.6E-04	<i>0.475</i>	<i>6.8E-05</i>
12	0.720	9.7E-12	0.679	3.6E-10	0.448	1.6E-04	<i>0.476</i>	<i>6.5E-05</i>
13	0.719	1.0E-11	0.681	3.2E-10	0.447	1.7E-04	<i>0.479</i>	<i>5.7E-05</i>
14	0.720	9.9E-12	0.684	2.5E-10	0.445	1.8E-04	<i>0.476</i>	<i>6.5E-05</i>
15	0.719	1.0E-11	0.685	2.2E-10	0.444	1.9E-04	<i>0.471</i>	<i>7.9E-05</i>
16	0.719	1.0E-11	0.687	1.9E-10	0.443	1.9E-04	<i>0.465</i>	<i>1.0E-04</i>
17	0.719	1.0E-11	0.688	1.7E-10	0.442	2.0E-04	<i>0.460</i>	<i>1.2E-04</i>
18	0.719	1.1E-11	0.690	1.5E-10	0.442	2.1E-04	<i>0.460</i>	<i>1.2E-04</i>
19	0.718	1.2E-11	0.691	1.4E-10	0.439	2.2E-04	<i>0.457</i>	<i>1.3E-04</i>
20	0.718	1.2E-11	0.692	1.2E-10	0.439	2.3E-04	<i>0.458</i>	<i>1.3E-04</i>
21	0.717	1.3E-11	0.693	1.2E-10	0.440	2.2E-04	<i>0.462</i>	<i>1.1E-04</i>

Table S3. Results of the correlation analysis between the average of total injection rate into Prati9 and Prati29 wells, $IN(\text{both})$, and the degree of disordering of seismic sources, ZZ , and its components, Δ_r , Δ_M , Δ_ϕ for the phase F2. The correlation have been evaluated for ZZ , Δ_r , Δ_M , Δ_ϕ delayed from 0 to 21 days with respect to $IN(\text{both})$. The results based on Spearman rank correlation are in italics.

Delay [days]	ZZ		Δ_r		Δ_M		Δ_ϕ	
	Corr. coef.	p-value	Corr. coef.	p-value	Corr. coef.	p-value	Corr. coef.	p-value
0	-0.603	2.9E-02	-0.199	5.1E-01	-0.321	2.8E-01	-0.195	5.2E-01
1	-0.587	3.5E-02	-0.176	5.6E-01	-0.338	2.6E-01	-0.183	5.5E-01
2	-0.571	4.2E-02	-0.154	6.2E-01	-0.354	2.3E-01	-0.171	5.8E-01
3	-0.554	4.9E-02	-0.131	6.7E-01	-0.371	2.1E-01	-0.159	6.0E-01
4	-0.538	5.8E-02	-0.108	7.3E-01	-0.387	1.9E-01	-0.147	6.3E-01
5	-0.521	6.8E-02	-0.085	7.8E-01	-0.403	1.7E-01	-0.135	6.6E-01
6	-0.505	7.8E-02	-0.063	8.4E-01	-0.420	1.5E-01	-0.123	6.9E-01
7	-0.485	9.3E-02	-0.035	9.1E-01	-0.438	1.3E-01	-0.111	7.2E-01
8	-0.469	1.1E-01	-0.013	9.7E-01	-0.454	1.2E-01	-0.098	7.5E-01
9	-0.452	1.2E-01	0.009	9.8E-01	-0.471	1.0E-01	-0.085	7.8E-01
10	-0.436	1.4E-01	0.031	9.2E-01	-0.488	9.1E-02	-0.072	8.2E-01
11	-0.419	1.5E-01	0.052	8.7E-01	-0.502	8.1E-02	-0.060	8.4E-01
12	-0.402	1.7E-01	0.074	8.1E-01	-0.519	6.9E-02	-0.047	8.8E-01
13	-0.386	1.9E-01	0.096	7.6E-01	-0.535	5.9E-02	-0.033	9.2E-01
14	-0.369	2.1E-01	0.117	7.0E-01	-0.552	5.1E-02	-0.019	9.5E-01
15	-0.352	2.4E-01	0.139	6.5E-01	-0.567	4.3E-02	-0.006	9.9E-01
16	-0.335	2.6E-01	0.161	6.0E-01	-0.582	3.7E-02	0.007	9.8E-01
17	-0.317	2.9E-01	0.182	5.5E-01	-0.597	3.1E-02	0.020	9.5E-01
18	-0.299	3.2E-01	0.204	5.0E-01	-0.610	2.7E-02	0.032	9.2E-01
19	-0.281	3.5E-01	0.225	4.6E-01	-0.622	2.3E-02	0.043	8.9E-01
20	-0.264	3.8E-01	0.247	4.2E-01	-0.640	1.9E-02	0.058	8.5E-01
21	-0.245	4.2E-01	0.268	3.8E-01	-0.651	1.6E-02	0.069	8.2E-01

Table S4. Results of the correlation analysis between the average of injection rate, IN , and the degree of disordering of seismic sources, ZZ , and its components, Δ_r , Δ_M , Δ_ϕ for the phase F3. The correlation have been evaluated for ZZ , Δ_r , Δ_M , Δ_ϕ delayed from 0 to 21 days with respect to IN .