Seismic moment and injection efficiency evolution during EGS projects (http://doi.org/10.5880/GFZ.4.2.2020.001)

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1. Licence

2. Citation

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3. Data Description

The here provided data are part of a broader analysis of past and present stimulation projects, revealing that the temporal evolution and growth of maximum observed moment magnitudes may be linked directly to the injected fluid volume and hydraulic energy. Analyzed projects include the most prominent European Enhanced Geothermal System (EGS) projects in Basel, Switzerland (BAS) [*Häring et al.*, 2008] and Soultz-sous-Forêts (STZ), France. In Soultz, three

different stimulations over the course of 10 years were performed in different wells and different depths. Therefore, we differentiate between the injections in 1993 (STZ93), 2000 (STZ00), and in 2003 (STZ03) [*EOST & GEIE EMC.*, 2017; 2018a; b]. We also included the deepest EGS Project to date (St1), located in Helsinki, Finland [*Kwiatek et al.*, 2019]. Furthermore, we included the fluid-injection experiment from the German super deep scientific drilling hole (KTB) [*Baisch et al.*, 2002], two Australian EGS projects, located at Paralana (Para) [*Albaric et al.*, 2014] and the 2003 Cooper Basin (CBN) injection [*Baisch et al.*, 2006], as well as the EGS project near Pohang, South Korea [*Ellsworth et al.*, 2019]. Finally, we also considered a single well injection period at the Berlín geothermal field (BGF), El Salvador, representing the only hydrothermal site considered here [*Kwiatek et al.*, 2014]

For each project the cumulative volume injected is provided along with the applied hydraulic energy, maximum observed seismic moment, cumulative seismic moment, and injection efficiency as tab separated ASCII files with the .csv extension. All stimulation files are combined into a single .zip archive.

3.1. Data processing

The parameters presented are the maximum observed seismic moment during and following the stimulation $M_{0,\mathrm{max,obs}}$, and cumulative seismic moment $M_{0,\mathrm{cum}}$ with injected fluid volume and hydraulic energy E_{hyd}, i.e. the product of well-head pressure and injected volume integrated over time. $M_{0,\mathrm{cum}}$ for each sequence is corrected accounting for missing events caused by different magnitude of completeness using computed synthetic catalogs. Furthermore seismic injection efficiency I_{E}, i.e. the ratio of cumulative radiated energy and hydraulic energy for the different stimulation projects are compared. The radiated seismic energy E_0 for each event is estimated from the seismic moment M_0 and stress drop $\Delta\sigma$ as:

$$E_0 = \Delta\sigma \frac{M_0}{2G} \eta_{\mathrm{R}}, \tag{1}$$

where G is the shear modulus calculated as $G = \rho V_s^2$, with density ρ and shear wave velocity V_s, and η_R is the radiation efficiency.

4. File description

4.1. File inventory

One single zip-file contains 10 tab separated ASCII files with the .csv extension, each corresponding to one individual EGS project.

4.2. File naming convention

Files are named according to the EGS project.

4.3. Description of data tables

All files supplied herein have the same structure.

4.3.1. File example

Column header	Unit	Description
V	Cubic metre	Cumulative volume injected
Ehyd	Joule	Applied hydraulic energy
MaxM0	Newtonmeter	Maximum observed seismic moment
CumM0	Newtonmeter	Cumulative seismic moment
IE	-	Injection efficiency

5. References

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