An application of induced event interferometry approach at The Geysers Geothermal Field, California, USA

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While the classical tomography approaches, e.g., P-, S-, and/or surface-wave traveltime tomography, provide a general structure of the Earth's interior, new developments in signal processing of interferometry approaches are needed to obtain a high-resolution velocity structure. If the number of earthquakes is adequate, the virtual seismometer method may be a solution in regions with sparse instrumental coverage. Theoretically, the empirical Green's functions between a pair of events can be retrieved using earthquake's cross-correlations. Here, an event interferometry approach was used on a very small scale around Prati-9 and Prati-29 injection wells in the NW of The Geysers Geothermal Field. The study region experienced intense injection-induced seismicity. We selected all events with location uncertainties less than 50 m in a cuboid of the horizontal side ~1 × ~2 km and the vertical edge at depths between 1.0 and 2.0 km. The cuboid was cut into 100m thick layers, and we applied to events from each layer criteria enabling a quasi 2D approach. After calculating the Rayleigh wave group velocity dispersion curves, further processing was performed at a 0.2s period, selected based on the sensitivity kernel criterion. Finally, the relative velocity model of each layer at the depth z was obtained by subtracting the velocity model of the just overlying layer (at the depth z-100m) from the model of this layer. Our resultant velocity model in the study area indicated four low-velocity anomalies. The first one can be linked by the two layers interface topography variation at the top of the cuboid (depth 1000 m). The secondary faults can cause the second low-velocity anomaly. The other two anomalies look to result from fluid injection into Prati-9 and Prati-29 wells.

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