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A Cluster of Deep Crustal Seismicity in the Northern Alpine Foreland of Austria

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Within ten days of August 2008 a cluster of nine earthquakes was detected by the Zentralanstalt für Meteorologie & Geodynamik (ZAMG) and other institutions in adjacent countries in the northwestern region of Austria, which until then was unremarkable in terms of its naturally occurring seismicity.

At that time, the events with estimated magnitudes between ≈2.0 and 3.8, were located at depths of about 10-20 km in the general vicinity of Braunau (≈13.5° E) between the Bohemian Massif and the Eastern Alps, in an area of elevated geothermal heatflow (80-90 mW/m^2) with active geothermal energy production.

A relocation of these events with NonLinLoc (Probabilistic Non-Linear Location algorithm) and HypoDD (Double-Difference location scheme) using a 3D-velocity model ($\Delta_{x,y,z}$=1 km) of Austria revealed a very dense clustering of these events, and resulted in anomalously deep foci within 10 km of the Moho.
Coherent focal mechanisms with T-axes striking NE-SW were determined for the strongest of the events through both, waveform-inversion (gCAP) and P-wave onset polarities (HASH).

Further, the waveforms of all events exhibit high similarity (corr. of $> 80\%$), as is typically observed in conjunction with densely clustered seismicity. Using a crosscorrelation technique (Subspace Detection Algorithm) we found previously undetected, weaker events during that time span associated with the same cluster.

Similarly deep, lower crustal seismicity in the northern Alpine foreland has previously been observed and investigated in the Swiss part of the Central Alps west of 10° E, where the deepest events have been found to closely follow the Moho of the subducting European lithosphere.

With the cluster of events reported on in this study apparently being singular in time and space, and in the absence of additional events observed at comparable depths in the wider region, we at this point do not infer any conclusive information as to the reasons of the observed seismicity.
In light of an assumed Adriatic subduction counterclockwise northwestward under the Eastern Alps however, we do believe that our observation could be connected to active subduction processes, and thus may give valuable insight into the local stress state and possible dynamics of the lithosphere east of the European-Adriatic “slab gap” at ≈12° E.