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Thermal stress field and seismicity beneath the Vrancea relict subduction zone

V.C. Manea (1,2), M. Manea (1), L. Besutiu (3) and M. Tumanian (3)

(1) Computational Geodynamics Laboratory, Geosciences Center, UNAM, Campus Juriquilla, Mexico , (2) Seismological Laboratory, Caltech, Pasadena, Ca, USA, (3) Institute of Geodynamics of the Romanian Academy

Despite many years of research, the origin of intermediate-depth earthquakes located in a full intra-continental environment, within the bending zone of East Carpathians (the so called Vrancea active seismic zone), still represents a challenge for geoscientists. Several attempts have been made to explain the unusual seismicity, mainly based on subduction related mechanisms. Since this issue is an ongoing debate, alternative models are proposed. In this study we offer a new model based on the existence of an unstable triple junction between the three lithospheric compartments joining the Vrancea area: the East European Plate (EEP), the Moesian Microplate (MoP) and the Intra-Alpine Microplate (IaP). According to this model, the opening of the West Black Sea basin (approx. 110 Ma ago) provided the necessary speed excess for MoP to transform the junction into an unstable transform-transform-compression (FFT) triple junction, and the central lithospheric compartment between MoP, EEP and IaP being pushed down by tectonic forces. The sinking of the lithospheric compartment is an ongoing process probably due to tectonic forces generated by the northwestward push generated by the Arabian Plate dynamics. Also the eclogitization processes at the bottom of the sunken compartment might contribute. Strong evidence for active sinking is provided by non-tidal gravity change and negative deformation of the crust recorded above the epicenter area. The penetration of the hotter upper mantle by a colder lithospheric compartment is consequently followed by thermo-baric accommodation phenomena that might be responsible for the intermediate-depth seismicity in the region. In this paper, we present a new model of stress generation induced by

the non-uniform temperature contrast in the descending lithospheric compartment beneath Vrancea. The thermal evolution associated with the unstable triple junction is studied along a 2D profile crossing the bending zone of East Carpathians from West to East. The time evolution of the thermal structure along the profile was obtained by solving the heat transfer equation with advective and heat generation terms, using a finite differences technique. Based on the obtained thermal structure, the thermal stress inside the sunken compartment core is calculated using a finite element approach. The calculation results show that tensile stresses ($>$ 20 MPa) are accommodated inside de slab between 40 km and 160 km depth. These thermal stresses inside the slab interior are consistent with the normal fault intermediate-depth earthquakes in the area. Our calculations show that thermal stresses due to non-uniform reheating of subducting slabs play a considerable role on the total state field and might provide an original approach to explain the unusual seismicity in the Vrancea area at intermediate depths.