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From geodynamics to magmatism: Subduction zone evolution, continental collision and post-collisional magmatism in Italy

M.J.R. Wortel, M.J. van Bergen, D.M.A. van de Zedde, W. Spakman

Department of Earth Sciences, Utrecht University, P.O. Box 80021, 3508TA Utrecht, the Netherlands (wortel@geo.uu.nl)

In this contribution we outline a novel approach to studying magmatism by starting from geodynamics, in this case the structure and evolution of the subduction zone in the Italian region. Central-southern Italy offers a unique opportunity to study the relation between upper mantle structure, subduction zone evolution and (K-rich) post-collisional volcanism. In our model for the geodynamic evolution of the region the slab detachment process plays an important role (see Wortel and Spakman, Science, vol. 290, p. 1910-1917, 2000). The primary indication for relatively recent (Late Miocene to Present) shallow slab detachment in central Italy comes from seismic tomography studies, but other geological, and numerical modeling studies have substantiated the inferences. We use our geodynamical model as a basis for the analysis of the relation between terminal stage subduction and post-collisional magmatism in central-southern Italy. In particular, we address the question to which extent the inferred geodynamic framework is capable of generating the characteristic features of volcanism in the Roman Province.

In our modelling the rotation of the Apenninic plate boundary leads to the prediction that slab detachment has not occurred simultaneously along the plate boundary, but started in Central Italy. Where it occurred at mid-lithospheric depths, it strongly affected the thermal evolution of the plate boundary and exposed crust and lithospheric mantle to temperatures characteristic for upper mantle depths ($>$ 100 km). In addition, decompression of the asthenospheric material filling the gap upon shallow slab detachment contributed to the magma generation. As a whole, it is a naturally short-lived phenomenon. We conclude that the K-rich signature, the compositional diversity, and

the spatial-temporal variations of the regional magmatism are a natural consequence of the geodynamics as represented in our shallow slab detachment model.

For several other regions suggestions have been made concerning the possible or likely relevance of the slab detachment (slab breakoff) process for the generation of post-collisional (K-rich) volcanism. Our approach applied in this active region, where slab detachment is inferred to have taken place recently, has the advantage of implicitly incorporating enormous amounts of information acquired by geophysical and geological studies independent of petrological data. Thus, our study may serve as a calibration of the relation between subduction zone evolution and post-collisional (K-rich) volcanism and may shed light upon post-collisional magmatism in older regions of continental collision and suturing