Forum Comment

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The life cycle of subcontinental peridotites: From rifted continental margins to mountains via subduction processes

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Vannucchi et al. (2020) present an interesting attempt to frame the origin and emplacement of serpentinized peridotites (SPs) into the Wilson cycle. Besides the well-known examples of SPs exhumed by extensional faulting along passive margins, Vannucchi et al. illustrate the case of the Calabrian accretionary wedge (CAW) intruded by serpentinite diapirs, and make the point that fossil examples of this last emplacement mode can be found in the northern Apennines, Italy. It can be argued that the occurrence of serpentinite diapirs in the CAW is not supported by evidence, and that a diapiric emplacement of serpentinite is not appropriate to explain the External Ligurian (EL) ophiolites of the northern Apennines.

SERPENTINITE DIAPIRS IN THE CAW

Vannucchi et al. infer that the Ionian lithospheric mantle was serpentinized during the Mezozoic opening of the Tethyan ocean, and subsequently the SPs have been mobilized as diapirs within a Pleistocene transtensional belt. Serpentinization is assumed to be controlled by fluid circulation along Mesozoic transform faults, with the Alfeo Fault System as the main one of these faults. A segmented ocean-continent transition (OCT) in the southern part of the CAW is taken as an indication of the occurrence of transform faults (Fig. 1). Recently acquired refraction data (Dellong et al., 2020), however, show that there is only oceanic crust in that sector of the Ionian Sea.

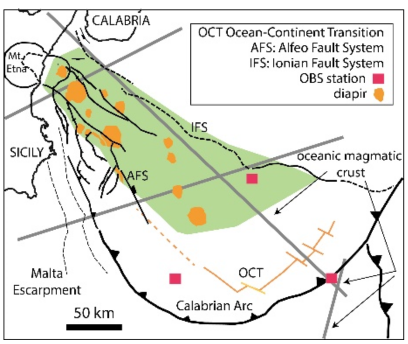

Figure 1. Tectonic sketch of the western Ionian region. Main structural features from Argnani (2020). Serpentinite diapirs, inferred Pleistocene transtensional belt (green pattern) and OCT from Vannucchi et al. (2020). OBSs from D'Alessandro et al. (2016). Thick gray lines are refraction profiles (Dellong et al., 2020).

Vannucchi et al. point out that the density of SP is 2.4–2.5 g/cm^3 for a 100% serpentinization. However, the degree of serpentinization inferred for the Unit I layer (their figure 1C) is much lower. A receiver functions study (D'Alessandro et al., 2016) gives a Vp of 6.8–7 km/s, corresponding to a serpentinization of 55%–65%. At pressure ≥200 MPa, these Vp values imply a density >2.8 g/cm^3 (Christensen, 2004), which is greater than the density of the CAW Cenozoic sediments. Buoyancy seems an unlikely mechanism for serpentinite diapirs to rise, even assuming a transtensional trigger, and it is worth noting that seismic data (Polonia et al., 2017) do not clearly image any diapiric structure. Moreover, contrary to the results of D'Alessandro et al. (2016), refraction data in the same area show little evidence of SPs in the oceanic basement (Dannowski et al., 2019).

THE OPHIOLITES OF THE NORTHERN APENNINES

Using the CAW serpentinite diapirs' concept, Vannucchi et al. attempt to reassess the origin of the ophiolites of the EL units. For various reasons, this analogy does not hold.

Vannucchi et al. infer that in the CAW lithospheric transtensive faults trigger upwelling of serpentinite material from the lower plate. This transtensional regime is therefore related to a specific tectonic setting and can hardly be generalized to other subduction settings, like the early stages of the northern Apennines.

The presence of variably serpentinized ophiolite blocks embedded in highly sheared deep-water sediments, with little or no preserved stratigraphic relationships, is typical of subduction mélange complexes worldwide. Serpentinite diapirs alone cannot account for the ophiolite rocks of the EL, where fresh peridotites, gabbros, and basalts are also common (e.g., Tribuzio et al., 2004), leaving to diapirs a minor, ultimately unnecessary contribution. The classic mechanism of scraping off sediments and oceanic basement rocks from the lower plate during subduction can adequately explain the observables, without the need of a new paradigm.

The statement that "ophiolitic blocks crop out along well-defined tectonic lineaments that orthogonally cut the entire Apennine orogenic pile" is poorly supported because there is no clear pattern in the distribution of ophiolite outcrops. Furthermore, this interpretation poorly fits the evolution of the northern Apennines. In the past 30 m.y., the EL units have been emplaced on the continental margin of Adria, whose units have also been progressively deformed. Even assuming that the alignments of serpentinite diapirs are preserved in the highly allochthonous EL, the probability that the diapirs track the deep transverse alignments of the continental margin seems unrealistic, also considering that paleomagnetic data show significant counterclockwise rotations of the Adria-derived Apennine units and the overlying Ligurian complex (Muttoni et al., 2000).

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