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The Armenian and NW Anatolian ophiolites: new insights for the closure of the Tethys domain and obduction onto the South Armenian Block and Anatolian-Tauride Platform before collision through dynamic modeling

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In the Lesser Caucasus three main domains are distinguished from SW to NE: (1) the South Armenian Block (SAB), a Gondwanian-derived continental terrane; (2) scattered outcrops of ophiolites coming up against the Sevan–Akera suture zone; and (3) the Eurasian plate. The Armenian ophiolites represent remnants of an oceanic domain which disappeared during Eurasia-Arabia convergence. Previous works using geochemical whole-rock analyses, 40Ar/39Ar and paleontological dating have shown that the ophiolite outcrops throughout this area were emplaced during the Late Cretaceous as one non-metamorphic preserved ophiolitic nappe of back-arc origin that formed during Middle to Late Jurassic. From these works, tectonic reconstructions include two clearly identified subductions, one related to the Neotethys subduction beneath the Eurasian margin and another to intra-oceanic subduction responsible for the opening of the back-arc basin corresponding to the ophiolites of the Lesser Caucasus. The analysis of the two stages of metamorphism of the garnet amphibolites of the ophiolite obduction sole at Amasia (M1: HT-LP peak of P = 6-7 kbar and T > 630°C; M2; MP-MT peak at P = 8-10 kbar and T = 600°C) has allowed us to deduce the onset of subduction of the SAB at 90 Ma for this locality, which age coincides with other paleontological ages at the obduction front. A preliminary paleomagnetic survey has also brought quantification to the amount of oceanic domain which disappeared by subduction between the SAB and Eurasia before collision. We propose a dynamic finite element model using ADELI to test the incidence of parameters such as the density of the different domains (or the interval between the densities), closing speed (or speeds if sporadic), the importance and interactions of mantle discontinuities with the subducting lithosphere and set a lithospheric model. Our field observations and analyses are used to validate combinations of factors. The aim is to better qualify the predominant factors and quantify the conditions leading to the onset of obduction, the paradox of dense oceanic lithosphere emplaced on top of a continental domain, after subduction and prior to collision.

The results of this modeling are also compared to new observations of the assumed eastward extension of this ophiolitic nappe in NW Anatolia. Analyses of the Refahiye ophiolites show similar geochemical signatures as the Armenian ophiolites, due to a similar setting of formation (back-arc). The impact of the obduction of such a vast oceanic domain is not to be taken for granted when considering the following collision stage.