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Tectono-metamorphic evolution of the Tavşanlı zone, Western Anatolia: implications for mechanical coupling during subduction/obduction processes

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Obduction (i.e. emplacement of a dense oceanic lithosphere on top of a continent) and associated continental subduction provide insights into the rheology of the lithosphere and inter-plate mechanical coupling that usefully complements those inferred from normal oceanic subduction beneath continents. Structural and petrological data from the Tavşanlı zone are herein used to highlight processes occurring along the subduction interface from initial obduction stages (i.e. initiation of intra-oceanic subduction witnessed by metamorphic soles) to continental subduction (represented by high-pressure low-temperature, HP-LT rocks). The Tavşanlı zone (Western Anatolia) belongs to the İzmir-Ankara suture zone, which separates the Pontides and Anatolide-Tauride block. It represents a very well preserved late Cretaceous subduction interface, thanks to only mild, later collision. The Tavşanlı zone is divided in three main tectonic units related to (either continental or oceanic) subduction and obduction, respectively, which are from bottom to top: (i) the distal cover of the subducted north facing continental margin of the Anatolide-Tauride block (Orhaneli unit), which yields one of the lowest thermal gradients on earth (i.e. 5°C/km, with peak T and P of 430°C/22-24 kbar); (ii) an accretionary complex made of low-grade, subducted ocean-derived metamorphic rocks; (iii) the non-metamorphic obducted ophiolite, underlain by a thin metamorphic sole, which is found as klippen south of the İzmir-Ankara suture zone. Systematic sampling and structural work allow us to reappraise the nature, internal structure and P-T conditions of the accretionary complex sandwiched between the lower continental and upper oceanic plates. Two major tectonic units (termed complex 1 and 2) are recognised based on metamorphic grade and structural position with respect to the continental margin. Metamorphic conditions range from incipient HP-LT metamorphism (complex 1) to blueschist facies (complex 2). Based on the first occurrence of Fe-Mg carpholite in the Tavşanlı zone and on pseudosection calculations, PT estimates of 300-400°C and 13-16 kbar are inferred for complex 2. Internal deformation of the accretionary complex points to the underplating of kilometre-scale units at different depths along the plate interface and to contrasting dynamics with respect to both the underlying continental unit and the metamorphic sole above. The metamorphic sole, which shows variable HP-LT overprinting beneath the ophiolite, also permits to constrain the dynamics and timing of thermal reequilibration of a subduction zone after the early obduction stages. On this basis we propose a refined subduction history for the Tavşanlı zone and the northern Anatolide-Tauride margin. Inter-plate mechanical coupling, in particular, is discussed in the light of these new data and of their comparison with the Semail ophiolite case study in Oman.