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Thermal Evolution of Juvenile Subduction Zones — New Constraints from Lu–Hf Geochronology on HP oceanic rocks (Halilbağı, Central Anatolia)

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The thermal structure of subduction zones plays a key role on mechanical and chemical processes taking place along the slab–mantle interface. Until now, changes through time of this thermal structure have been explored mostly by the means of numerical simulations. However, both "warm" (i.e. epidote-bearing), and "cold" (i.e. lawsonite-bearing) HP oceanic rocks have been reported in some fossil subduction complexes exposed at the Earth's surface (e.g., Franciscan Complex, California; Rio San Juan Complex, Hispañola; Halilbağı Unit, Central Anatolia). These a-priori "incompatible" rocks witness different thermal stages of ancient subduction zones and their study might provide complementary constraints to numerical models.

To decipher the meaning of these contrasting metamorphic rocks in the Halilbağı Unit, we are carrying out Lu–Hf geochronology on garnet (grt) and lws from a variety of HP oceanic rocks, as well as the metamorphic sole of the overlying ophiolite. We selected five samples that are representative of the variety of metamorphic evolutions (i.e. peak conditions and P–T paths) encountered in this area.

Preliminary analyses yielded 110 Ma (grt–hbl isochron) for a sub-ophiolitic grt amphibolite; 92 Ma (grt–omp) for an eclogite with prograde and retrograde ep; 90 Ma (grt–omp) for an eclogitic metabasite with prograde ep and retrograde ep+lws; 87 Ma (grt–gln) for a lws eclogite with prograde ep; and 86 Ma (grt–gln) for a blueschist with prograde and retrograde lws. These ages are mainly two-point isochrons. Further-refined data will be presented at the EGU General Assembly 2015, in Vienna.

The consistent younging trend from "warm" to "cold" metamorphic rocks revealed by these first-order results points to metamorphic-sole formation during the initiation of intra-oceanic subduction at ∼110 Ma, and subsequent cooling of the slab–mantle interface between 92 and 86 Ma. Therefore, the contrasting metamorphic evolutions encountered in the Halilbağı Unit record the progressive thermal maturation of the juvenile Neotethyan subduction zone. This period of ∼23 myr between subduction initiation and thermal "steady state" is significantly shorter than that obtained for the Rio San Juan Complex (∼60 myr; Krebs et al. 2008, Lithos, 103, 106–137), but compares well with that for the Franciscan Complex (∼22 myr; Anczkiewicz et al. 2004, EPSL, 225, 147–161) and falls in the range predicted in numerical simulations (e.g., Gerya et al. 2002, Tectonics, 21/6, 1056).