Protracted exhumation of eclogites and blueschists of the Voltri Group, Western Alps

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The processes that exhume high-pressure metamorphic rocks in subduction channels are enigmatic. Specifically, the duration over which exhumation occurs is loosely constrained for most high-pressure terranes, due to the absence of eroded high-pressure rocks [1]. The Voltri Massif and Tertiary Piedmont Basin (TPB), Ligurian Alps, Italy preserve a unique geologic relationship: bedrock eclogite-facies metamorphic rock directly overlain by conglomerates containing eclogite and blueschist clasts. In this setting, high-precision exhumation rates, not dependent on low-temperature thermochronology, can be determined by combining the P-T-t history of eclogite clasts and the depositional age of sediments. These rates directly inform tectonic models for the assembly of the Alps and the mechanisms by which high-pressure low-temperature metamorphic rocks are exhumed. In this study, we present new white-mica Rb-Sr geochronologic data for Voltri eclogites and TPB eclogite clasts. Paragonite from a garnet+omphacite+glaucophane bedrock sample yields an isochron age of 45.8±2.8 Ma that we interpret as the age of peak high-pressure metamorphic conditions in the Voltri Massif; white mica sampled from lineated Voltri Group schists preserve exhumation-related ages ~30 Ma. Blueschist clasts from the base of the Tertiary Piedmont Basin yield ages around 43±0.8 Ma whereas a calc-schist clast yields an age of 33.2±1.7 Ma, consistent with greenschist facies retrogression during exhumation of the high-pressure parageneses.

Combined with phase equilibria constraints on the P-T conditions of peak and retrogressive metamorphism, these data confirm that the Voltri Group underwent high-pressure metamorphism over an ~7 Myr period in which subduction and exhumation occurred concurrently. Exhumation occurred at mm/yr rates, similar to rates derived for other oceanic-derived high-pressure units along the Alpine chain. Finally, these results also corroborate previous $^{40}Ar/^{39}Ar$ investigations into the tectonic history of the Voltri Massif [2].

[1] Agard et al., 2009. Earth-Science Reviews 92.1-2: 53-79;
[2] Federico et al., 2005. EPSL 240: 668-680.