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Repeated brittle deformation under blueschist- to subgreenschist-facies conditions during exhumation of subducted oceanic crust (Bantimala Complex, Sulawesi)

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The exhumation of deeply subducted oceanic crust is a crucial process to understand the geodynamics of subduction zones and it is therefore a challenge to deduce the operating processes from rocks of paleosubduction zones. The exhumation of oceanic crust is either driven by a weak low-density surrounding material (e.g. serpentinite) or by the upward directed motion of low-density subducted continental crust (Agard et al., 2009).

We are presenting here exhumed oceanic HP metamorphic rocks exposed in the Bantimala Complex of SW-Sulawesi (Indonesia), which are not embedded in a serpentinite matrix and that show evidence for repeated brittle deformation during uplift. The complex derives from a Cretaceous subduction, which ceased after the collision between a continental fragment and the Sundaland continent (Wakita, 2000). The now exposed oceanic crust was generally subducted to a depth of about 90 km. Coesite-bearing rocks underline that UHP conditions were reached during subduction (Parkinson & Katayama, 1999). Based on trace element signatures the oceanic crust was dominantly composed of MORB, some samples also show OIB and oceanic arc signatures. Brecciation occurred during uplift at different depths within the subduction zone. Brecciated eclogites with rehydrated glaucophane-bearing mineral assemblages in the matrix mark the deepest recognized depth of brecciation. Blueschist clasts within a blueschist matrix indicate brittle deformation in the stability field of lawsonite+albite blueschists (0.7-1.3 GPa, T_{max}=460°C). Other breccias are composed of greenschist clasts within a greenschist matrix containing albite, epidote and chlorite, and subgreenschist clasts in a subgreenschist matrix contain pumpellyite, chlorite and quartz (T=250-350°C and P_{max}=0.5 GPa). Together, the breccias indicate repeated brittle deformation events during the exhumation process. Eclogites formed at the same pressure (2.5-2.6 GPa) but varying peak temperatures (ΔT=150°C) indicate a displacement of their original stratigraphy within the slab. These observations, the interlayering of the exhumed HP oceanic crustal rocks with oceanic sediments of the accretionary wedge and the lack of a serpentinite matrix point to an exhumation mechanism that was not driven by a classical subduction channel process. The driving force for the exhumation is assumed to be a subducted continental fragment that carried the oceanic crust upwards during its buoyancy-driven exhumation. The new observation reported here is that during exhumation the subducted HP rocks were tectonically imbricated with wedge sediments, which lead to repeated brittle deformation under different metamorphic conditions. The resulting deformation features can be explained by internal shearing of the subducted slab during exhumation and localized hydraulic fracturing that was associated with partial rehydration of the eclogites. The described exhumation process of the Bantimala complex indicates that deeply subducted oceanic crust can be exhumed without a buoyant surrounding matrix and brittle deformation may occur even at great depths and elevated temperatures.

References

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