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THE PRESERVATION OF HIGH-PRESSURE ROCKS DURING EXHUMATION: ECLOGITES, METAPELITES AND METAGRANITES

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The country rocks of eclogites rarely record the same or even comparable high- or ultrahigh-pressure conditions. This situation has caused prolonged discussions on the subject of in-situ HP-metamorphism versus tectonic emplacement of HP-rocks along the exhumation path for a number of high-pressure localities around the world.
Internal dehydration of a lithology, in combination with deformation, is the major factor governing the degree of reequilibration of a rock along the exhumation path. This study gives an overview and a quantitative outline of the most important reactions controlling dehydration in two important country rock lithologies (K-feldspar gneisses and high-pressure metapelites) and discusses the fluid interaction between eclogites and country rocks during subduction and exhumation.

Acidic orthogneisses with a typical paragenesis of K-feldspar + plagioclase + quartz + muscovite + biotite (+fluid) are 4-variant in the system NKCFMASH. Other minerals are usually accessory, even garnet and epidote are stable only as buffers of Mn and Fe^{3+}. They require external hydration during prograde high-pressure metamorphism in order to equilibrate to ambient HP-conditions by producing more siliceous micas. Any lack of external fluid or the disappearance of biotite stops reequilibration and thus prevents recording of HP-conditions. The same reactions cause dehydration during exhumation. Orthogneiss from shear zones or adjacent to metapelites and metabasites will take up external fluid on the prograde path and record the highest PT-conditions, but will also be the first to dehydrate upon exhumation, now hydrating other lithologies and probably refuelling shearzones.
Metapelites generally have a more complex mineralogy. The fluid bound in the structures of hydrous mineral like chlorite and chloritoid is only partly released, but partly transferred to other minerals like paragonite or phengite during a prograde oceanic or continental subduction event and is given off in large quantities upon exhumation. High-pressure metapelites can be preserved only if the PT-path remains within the stability fields of chlorite and paragonite or passes through them again on the retrograde limb. Rapid exhumation (isothermal decompression) very likely destroys almost any indication of former HP-conditions, giving rise to typical Barrow-type garnet-biotite-staurolite or -kyanite schists.

Metapelites of different bulk composition – Al-rich, Al-poor and sodic varieties – differ significantly in their ability to record various sections or points along the PT-path and should be used together with eclogites and gneisses to deduce a well-constrained PT-evolution for a certain area.

A thorough understanding of the dehydration behavior of orthogneisses and metapelites explains how different lithologies may interact during their metamorphic evolution and thus advances the tectonic interpretation of high- and ultrahigh-pressure terrains.

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