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Variscan-style UHPM belts: high pressures at different temperatures, high temperatures at different pressures, and crustal relamination

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The European Variscan belt is unusual in that it is a classic location for the study of regional low-pressure–high-temperature (LP–HT) metamorphism, migmatites and granites whilst at the same time being home to ultrahigh-pressure (UHP) metamorphic rocks such as coesite eclogite, microdiamond-bearing gneisses and garnet peridotite [1,2]. A further peculiarity is the widespread occurrence of felsic, metagranitic rocks: the type locality granulites. These orthopyroxene-free, garnet + kyanite + ternary feldspar-bearing rocks, typically known as high-pressure (HP) granulites, actually formed at HP-HT eclogite facies conditions [2,3], at around 340 Ma, and in some cases also contain microdiamond and/or coesite [4]. In addition to this (U)HP–HT unit there are other, slightly older (380–420 Ma) eclogite-bearing units that in some places experienced only amphibolite facies or lower grade conditions for retrogression but in other places show good evidence for short-lived granulite facies overprints [5,6,7]. In the most extreme cases, eclogites still with omphacite preserved exhibit a pyroxene hornfels overprint that yielded olivine-bearing symplectites in metabasaltic rock compositions [7], but still preserved growth zoning in relict garnet. The pyroxene hornfels facies conditions are identical to those deduced for the regional migmatitic cordierite + sillimanite + K-feldspar-bearing paragneisses. This mixture of rocks can be explained by subduction of a rift sequence (>380 Ma HP–MT stage, gneiss–metabasite complexes) followed by continent–continent collision and hot, deep subduction of continental crust (340 Ma UHP–HT stage). The buoyant upper crust of this subducted plate detaches due to partial melting-induced weakening and forces its way back up the subduction channel, at the same time incorporating a mixture of mantle peridotite slices. Local clinopyroxene-bearing, intermediate varieties of HP granulite preserve the best record of this history [8]. Once back at normal Moho depths, this hot HP granulite material spreads and accretes to the base of the crust (i.e. relaminates). In places this still hot, newly-accreted lower crust (HP granulite + garnet peridotite + eclogite) forms domes that rise to middle crustal levels, in places dragging up lower crustal rocks, and induces a short-lived HT overprint on the surrounding rocks. The most important consequence of this type of hot subduction–collision orogen is that the newly welded orogenic crust contains a low-density lower crust that has been relaminated and that may be considerably younger than its upper and middle crust. This is a major modification of the widespread view of how lower crust usually forms, i.e. by magmatic accretion

processes. It also has important implications for understanding the rejuvenation of continental plates with regard to ore mineral potential as well as seismic hazards.

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