P-T-time history of HP-UHP unit, and possible heat source for UHPM in deep subduction zone

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Since the first discovery of coesite-bearing UHP rocks from the Western Alps in 1984, many UHP terranes have been identified in global collisional orogenic belts. Exhumed UHP units occur as thin subhorizontal slabs, bounded by normal faults on top, and reverse faults on bottom, and sandwiched in amongst HP or lower grade units within orogenic belts. No UHP rocks have been reported from the Pacific-type orogenic belts. They are restricted to the orogenic belts younger than 750Ma reflecting much higher geothermal gradients in the Archean - Proterozoic Earth.

The UHP-HP unit constitutes only a portion of an entire collisional orogenic belt; many of UHPM rocks are overprinted by Barrovian zone granulite- to amphibolite-facies assemblages. The UHP-HP unit may represent the earlier exhumed pieces of rifted continental fragment from deep subduction depths prior to major continental collision such as the large Indian continent that cannot be subducted by its highly buoyant nature. The subsequent continent collision may have resulted in the kyanite-sillimanite Barrovian metamorphic overprint, but do not create UHP-HP rocks as suggested by many investigators.

The metamorphic facies series of the well-investigated UHP-HP belts such as the Kokchetav Massif, and the Dabie-Sulu terrane belongs to the HP intermediate type at lower grade part up to the epidote amphibolite facies. T increases from 300°C to 500-600°C as P reaches to 1 GPa, with a geothermal gradient of 15-20°C/km. But high-grade coesite- and diamond-zones follow an extremely cold geotherm about 5-9°C/km. HP and UHP-metamorphism at depths greater than 30 km, pressure increases drastically from 1 to 3 GPa with T-increase up to 700-1000°C. Such anticlockwise P-T path can be explained only by heating from underneath from subducting slab during initial subduction, followed by later minor heating presumably from hanging wall. Initial heating from subducting slab can be possible only if the oceanic lithospheric slab is young (< 5Ma.) and short-lived, consistent with the lack of coeval magmatic activity in all UHP terranes.