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Direct transfer of carbonate melts to the upper crust in the Kokchetav UHP collision zone: the story of Dubrava massif

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The release of elements from the subduction rocks is the key process of recycling of elements, yet constraints on recycling of the subducted matter remains limited to several key localities, which expose rocks that experienced subduction-related HP/UHP metamorphism. Even less is known about the subsequent fate of fluids released from the subducted rocks, because magmatic rocks coeval with HP/UHP metamorphism are rarely available. The Kokchetav massif, in the Northern Kazakhstan, remains is the world's best locality to study of ulra-deep subduction and melting of metasedimentary rocks.

The Dubrava massif of carbonatites, pyroxenites, and other alkaline rocks located southward from the main Kokchetav collision zone. The dating of zircon from carbonatite yielded the same age as UHP metamorphism and melting of the subducted sediments. The isotopic (C, O, Hf) characteristics of the Dubrava rocks are consistent with the derivation from the subducted UHP metasediments and show remarkable similarity to the carbonate melt inclusions from UHP rocks [1]. The coincidence of ages of metamorphic and igneous rocks suggests new constraints on the geometry of the paleo-subduction zone: the subduction must have been steep and deep. This geometry was among factors, which resulted in exhumation of unique diamond-bearing metamorphic rocks of the Kokchetav.

Therefore, the early Cambrian Kokchetav collision produced rather small volume alkaline magmatism, whereas supra-subduction magmatism was absent. This is similar to other major collision zones (e. g. Alps and Himalaya). The example of Dubrava suggests that UHP(T) metamorphism is the key environment of the generation of collision-related magmas. Carbonatites in collision belts can originate from melting of subducted sedimentary carbonates, experiencing important evolution during generation, mantle migration and emplacement. Many current models speculate on "melting of mantle metasomatized by subducted slab-derived fluids/melts". The example of Dubrava shows that remelting is unnecessary: there was no time for that and the intrusion was formed by melts originated from sediments. Similar melts might have contributed to the formation of some significant REE deposits in the collisional belts.

References

[1] Korsakov and Hermann (2006), Earth and Planetary Science Letters 241 (1-2), 104-118.