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Hybrid approach based on trace-element mapping and ^{190}Pt–^{186}Os and ^{187}Re–^{187}Os age determination of placer platinum-group minerals

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Ultramafic complexes originating from the lower crust and mantle have key information of melt generation and subsequent tectonic processes. For decoding the formation processes of ultramafic complexes, geochronological studies are required. However, deriving original information of ultramafic rocks is difficult due to the low abundances of radiogenic lithophile elements commonly used for geochronology, and the reset of radioisotope systems through potential secondary alteration or contamination of crustal materials. Faced with this problem, ^{190}Pt–^{186}Os and ^{187}Re–^{187}Os isotope systems are studied in this study. Age determination based on ^{190}Pt–^{186}Os and ^{187}Re–^{187}Os isotope systems is applicable to platinum-group minerals (PGMs) including isoferroplatinum (Pt_3Fe) and tulameenite (Pt_2CuFe) having high Pt/Os and low Re/Os.[1] The ^{190}Pt–^{186}Os isochron ages of PGMs can correspond to hydrothermal or metamorphic events, and ^{187}Re-depletion ages calculated from the initial $^{187}Os/^{188}Os$ can constrain the timing of the initial melt generation potentially corresponding to igneous ages. To scrutinise the meaning of the chronological data, trace-element mapping is also important, especially for identifying the causes of variation in Pt/Os, which is directly related to the meaning of ^{190}Pt–^{186}Os isochron ages.

In this study, hybrid approach based on trace-element mapping and ^{190}Pt–^{186}Os and ^{187}Re–^{187}Os age determination was applied to placer PGMs emanating from a pyroxenite complex in the Kurosegawa belt, Japan.[2] Trace-element imaging of PGMs identifies the high Pt/Os phase of chalcophile-element-enriched minerals occurring in the rim portion and visualise the diffusion profile of Os. The variation in Pt/Os is derived from both the high Pt/Os phase and the diffusion profile, potentially caused by a high-temperature metamorphic event. Subsequently, the resulting ^{190}Pt–^{186}Os isochron age is ca. 240 Ma corresponding to the potential metamorphism, and the obtained ^{187}Re-depletion age is ca. 650 Ma reflecting the initial formation of the host melt of pyroxenite. From this study, the importance of the hybrid approach with trace-element imaging analysis and radioisotope age determination is demonstrated.

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