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Chromium mineralization during deep continental subduction

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It is widely accepted that chromium (Cr) is a highly refractory element. The traditional view suggests that the mineralization of chromium is the result of mantle partial melting or melt-rock interaction in the shallow upper mantle. Several recent studies show that Cr-rich minerals or rocks can also be formed due to deep mantle upwelling in an oceanic subduction zone or spreading center. However, the possibility of Cr-mineralization in continental subduction zones is still poorly studied. The critical scientific question is: what nature and sources of fluids can lead to the activation, migration, and enrichment of Cr during the continental deep subduction? Here we report voluminous chromite-bearing Si-rich fuchsite quartzites in the Luofengpo ultramafic complex from the North Qaidam ultrahigh-pressure (UHP) metamorphic belt. The SiO_2 content of fuchsite varies from 48.44 to 50.24 wt.%, Cr_2O_3 ranges from 4.49 to 6.30 wt.%, and Si of fuchsite varies from 3.36 to 3.40 p.f.u (based on 11 oxygen atoms). According to the temperature (650-700 °C) during the peak period of UHP metamorphism in the Luofengpo area, the calculated pressure of fuchsite ranges from 3.38 to 3.83 GPa. Zircon U-Pb dating of chromite-bearing Si-rich fuchsite quartzites yields a formation age is ~450-420 Ma, comparable to the peak age of UHP metamorphism in the North Qaidam. Additionally, chromite is characterized by high content of zinc (ZnO=1.0~1.5%) and high value of Cr# (85-88), indicating that crystallization is related to fluid metasomatism. Considering the regional tectonic setting, the Cr-rich fluids were possibly derived from a hybrid melt which originated in a mantle wedge environment during deep continental subduction.