

Aqueous fluid drives rhenium depletion in the continental crust

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ABSTRACT

The underestimated rhenium (Re) concentration of continental crust is crucial for resolving the “missing Re puzzle” in the silicate Earth. Previous studies attributed the unknown Re reservoir in the continental crust to sulfide cumulates in the lower crust. However, the impact of aqueous fluids on Re abundance in the continental crust has been largely overlooked due to a lack of partition coefficients between fluids and silicate melts ($D_{\text{Re}}^{\text{fluid/melt}}$). To address this gap, we conducted partitioning experiments at 0.5 GPa and 850 °C under oxidized conditions (~hematite-magnetite buffer) to determine the $D_{\text{Re}}^{\text{fluid/melt}}$. Our goal was to investigate how fluid exsolution influences Re distribution in the crust. Our experiments revealed that the D values ranged from 4 to 108 for Re. Interestingly, these D values were not related to the concentration of F^- , Cl^- , and CO_3^{2-} , but increased as the H_2O fugacity in aqueous fluids increased. Numerical modeling suggests that magmatic fluids can extract a significant fraction of Re (~80%) during arc-magma differentiation, leading to Re depletion in the upper continental crust. Therefore, we believe that aqueous fluids play a dominant role in depleting Re content in the continental crust, whereas sulfide accumulation plays a very limited role.

Keywords: Rhenium, continental crust, aqueous fluid, partition coefficient, experimental petrology