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Contrasting oxidation states of low-Ti and high-Ti magmas of Emeishan Large Igneous Province: Insights into the role of magma fO_2 on controlling magmatic Ni-Cu sulfide and Fe-Ti oxide mineralization

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Magmatic Ni-Cu-(PGE) sulfide and Fe-Ti oxide deposits in plume-related large igneous provinces (LIPs) are typically associated with low-Ti and high-Ti magmas, respectively, but the controls behind this relationship remain unclear. Magma fO2 influences sulfur status and the relative timing of Fe-Ti oxide saturation in mafic magmas, which may help clarify this issue. Using the Emeishan LIP as a case study, we estimated the magma fO2 for high-Ti and low-Ti picrites based on olivine-spinel oxygen barometry, and the partitioning of V in olivine. The obtained fO_2 of the high-Ti series magma (FMQ+1.1~FMQ+2.6) is higher than that of the low-Ti series magma (FMQ-0.5~FMQ+0.5).The magma fO_2 of the high-Ti and low-Ti picrites containing Fo>90 olivine reveals that the mantle source of the high-Ti series is likely more oxidized than that of the low-Ti series. The 'lambda REE' modeling further indicates the high-Ti and low-Ti series may have been derived from an oxidized garnet pyroxenite mantle, and a relatively reduced spinel lherzolite mantle, respectively. The S contents at sulfide saturation (SCSS) of the two series magmas were calculated based on liquid compositions obtained from the alphaMelts modeling, and the results show that the low-Ti series magma could easily attain the sulfide saturation as it has low fO_2 with S being dominantly as S^{2-}. In contrast, the oxidized high-Ti magma is difficult to reach sulfide saturation but could crystallize Fe-Ti oxides at ~7 wt.% MgO. Therefore, contrasting fO2 between low-Ti and high-Ti magmas in LIPs may play a key role in their distinct metallogenic styles.