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Olivine in picrites from continental flood basalt provinces classified using machine learning

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ABSTRACT

Picrites, dominantly composed of highly forsteritic olivine, can serve as important constraints on primary magma composition and eruption dynamic processes in global continental flood basalt (CFB) provinces. Picrites are commonly divided into high-Ti and low-Ti groups based on whole-rock TiO_2 content or Ti/Y ratio. Here, we use an artificial neural network (ANN) to classify the individual olivine in picrites from global CFB provinces according to whether their parental magma is high-Ti or low-Ti to better understand the primary origin and magmatic processes. After training the ANN on 1000 olivine major element compositions data points, the network was able to differentiate chemical patterns for high-Ti and low-Ti olivine and classify olivine into correct types with an accuracy of >95%. Moreover, we find that two types of olivine mix in some single samples from Etendeka, Emeishan, and Karoo CFB provinces. Combining the results with chemical markers of source lithology, we suggest that the two types of olivine originate from two different sources and their olivine populations mixed during the ascent. This mixing then makes the spatial and temporal variation of picrites types in some CFB provinces unclear.

Keywords: Olivine, machine learning, picrites, chemical composition, classification