

Trace Elements in Olivine in Italian Potassic Volcanic Rocks Distinguish Between Mantle Metasomatism by Carbonatitic and Silicate Melts

PAPER



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Moscone South - Poster Hall

The Italian Peninsula is the site of intense subduction-related potassic magmatism with bimodal character in terms of silica activity: Ca-poor silica-saturated lamproitic rocks and Ca-enriched silica-undersaturated leucitites. Lamproitic magmas formed in the early phases of magmatic activity and were followed by leucititic magmas. The primary magmas are generated in the sub-continental lithospheric mantle at the destructive plate margin, and both series have olivine as the first crystallizing phenocrysts.

Trace elements in olivine phenocrysts are important in recognizing metasomatic effects on the mineralogy of the mantle source. Since Ni is the most compatible trace element in olivine, particularly in alkaline melts, modal changes of olivine in the source strongly affect its bulk partition coefficient, and therefore its content in primary melts and in olivine that crystallizes from them. The concentration of other compatible trace elements (e.g. Mn, Co) in olivine phenocrysts also depends on the abundance of olivine in the magma source.

Ni contents in olivine of the Italian rocks show a clear bimodal distribution. Olivine from lamproitic samples has systematically higher Fo and Ni contents, whereas olivine from leucititic rocks never exceeds Fo₉₂ and has markedly lower Ni, reaching among the lowest levels ever observed in olivine phenocrysts in primitive melts. The Mn/Fe ratio of olivine is also sensitive to changes of the modal abundance of olivine in the source, 100*Mn/Fe of olivine from lamproitic rocks never exceeds 2, while it is always >1.8 in leucititic rocks, meaning that the leucitite source regions are much richer in olivine.

Lithium is generally enriched in the crust and in sediments compared to the lithospheric mantle and to mantle-derived melts, so that Li in olivine above 10 ppm is suggested to indicate recycled sediments. Li contents are up to 35 ppm in leucititic olivines and up to >50 ppm in lamproitic olivines, confirming the recycling of crustal material into the mantle wedge.

Our data indicate opposite effects for metasomatism by silicate- and carbonate-rich melts, namely the removal and growth of olivine, respectively. This new line of evidence establishes olivine as a key tool to investigate the role of carbonatitic and silicate melts in the Earth's mantle.

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