The zircon record of Carboniferous partial melting in Silurian mafic rocks from the Lyonnais metamorphic complex (French Massif Central)

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Résumé

We report the petrological and zircon U-Pb and trace element study of metamafic rocks from the Saint-Joseph massif in the Lyonnais metamorphic complex. The samples are ultrabasic and predominantly composed of garnet–amphibole (up to 75–85%), with plagioclase–quartz (10–15%), titaniferous minerals (5–10%), and clinopyroxene relics (> 5%). Some samples show a layering marked by garnet abundance ranging from 0 to 40 %. Plagioclase coats the grain boundaries of garnet and amphibole porphyroblasts, resembling a melt pseudomorph. Thermodynamic modelling of a selected sample indicates that fluid-fluxed melting at 10–12 kbar and 800–900 ∘C, followed by cooling to _˜700 ∘C, can explain the assemblage garnet–amphibole–plagioclase–quartz–titanite. Separated zircon crystals commonly display a core with oscillatory, or sector zoning, rimmed by domains with complex convolute zoning. This pattern suggests polyphase zircon coupled dissolution-reprecipitation. The analyses of zircon rims show either a flat or a positive slope in the heavy REE pattern, irrespective of the date or intra-grain location. This feature is tentatively attributed to the variable garnet

*Intervenant

content in the rock layering. Zircon core and rim yield an equivalent smear of apparent ages between c. 360–320 Ma, interpreted as a result of melt-mediated dissolution-reprecipitation. One sample contains an additional zircon zone found as CL-dark cores with oscillatory or featureless zoning, and characterised by an exceptionally high trace-element content, *e.g.* up to 2000 ppm of U. These cores also yield a smear of apparent, on average, older ages, between c. 425–320 Ma. Nine-spots yield a concordia date of 423.8 ± 4.8 Ma with a MSWD of 0.99 regarded as the age of the magmatic protolith. The occurrence of a Silurian mafic magmatism may be related to mantle melting at the northern Gondwana margin, possibly in a suprasubduction setting. The sample records predominantly a Carboniferous fluid-fluxed partial melting event.