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Inclusions and inclusions in high pressure rocks

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Inclusions in porphyroblasts provide insightful information about an evolution of high pressure (HP) lithologies. Thanks to broad stability fields of host porphyroblasts (such as e.g. garnet) and their capability to enclose a variety solid and fluid phases, basically complete pressure-temperature-time evolutionary paths can be reconciled. Qualitatively, a geothermal gradient characterizing subduction can be estimated just based on an occurrence of such mineral indicators as carpholite, lawsonite and glaucophane as well as pseudomorphs after these phases. On the other hand, pressure conditions can be determined based on such index minerals as coesite and diamond that provide a direct evidence for peak conditions. Pseudomorphs after the latter and other HP phases including e.g. omphacitic clinopyroxene and phengitic mica inform about decompression.
A progress in trace elements and elastic geothermobarometry offers excellent quantitative tools for deciphering details of pressure-temperature paths. Application of trace elements thermometers, including Zirconium in Rutile, Titanium in Zircon and Titanium in Quartz, coupled with Quartz in Garnet elastic barometer became extremely handy for quantitative describing of (especially) prograde parts of P-T paths. The trace element and elastic thermobarometry results linked to interpretation of internal zoning of porphyroblasts and coupled with the outcome of traditional inclusion-host based conventional thermobarometry ensure gaining of a comprehensive set of information on an evolutionary path of a rock. Additionally, experimental homogenization of fluid and melt inclusions can be utilized to pinpoint P-T conditions of their entrapment. For HP rocks equilibrated in high temperatures, melt inclusions can give more reliable P-T constrains than those obtained using classical, thermodynamics-based calculations.
Additionally, inclusions of geochronometers (e.g. zircon, monazite, rutile, apatite etc.) can be used to assess the absolute and relative timing of growth of certain mineral assemblages via in-situ context-sensitive dating. This, in turn, can be directly utilized for a calculation of subduction-exhumation rate. Inclusions geochronology coupled with thermobarometry and kinematic analysis of inclusion trails can serve as a comprehensive ″micropetrological″ toolbox for reconciling a complete P-T-t-D evolution of HP rocks form initial burial, through deep subduction to exhumation to the near surface levels.

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