Formation pressures of eclogites from the Franciscan complex, California, from quartz-in-garnet elastic barometry

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The spatial, temporal, and pressure-temperature (P-T) relationships among high-pressure metamorphic rocks from within subduction complexes have key implications for their exhumation mechanisms and the rheological properties of the subduction interface. Structural, age, and P-T relationships among exhumed rocks may indicate, for example, (1) melange-style mixing during subduction and exhumation or (2) progressive underplating and coherent exhumation. Melange-style subduction ‘channels’ should exhibit a range of peak metamorphic grades in incorporated blocks, whereas coherent underplating may result in similar peak P-T conditions among blocks, especially from similar structural levels. Determining P-T conditions of high grade blocks is key for understanding these subduction zone endmembers, but constraining formation pressures of high grade blocks such as eclogites has historically been challenging for petrologists due to the lack of suitable barometers.

In this study, we compare pressure conditions recorded by spatially and temporally variant high-grade eclogite blocks from the Franciscan Complex in California. We use quartz-in-garnet elastic barometry, a technique that can reliably provide growth P conditions of garnets, to determine formation pressures of eclogites from sections of the northern (Jenner Beach, Ring Mountain, and Junction School) and the southern Franciscan Complex (Santa Catalina Island). Multiple eclogite blocks from Jenner Beach are analyzed, and single eclogite blocks from the other localities. By comparing garnet growth conditions from within a single outcrop and between distinct outcrops, we evaluate the local and regional spatial distribution of P conditions recorded by eclogites. Preliminary data from > 100 quartz-in-garnet inclusion pressures suggests that eclogites from the northern Franciscan record similar garnet growth conditions (~1.5 - 1.9 GPa), and pressures recorded on Santa Catalina Island differ slightly (~1.2 - 1.3 GPa). We use these results to address spatio-temporal variations of peak P recorded by eclogites and its implications for exhumation of the Franciscan complex, and further discuss how quartz-in-garnet pressures compare with conventional thermobarometry techniques.

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