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Acoustic microscopy of quartz and coesite: yet another way to look at old good metamorphic fellas

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A lot of emphasis has been given lately to SiO_2 polymorphs in metamorphic rocks. A development of quartz-in-garnet elastic barometry and Ti-in-quartz thermometry refocused attention of metamorphic petrologists on this chemically simple and ubiquitous mineral in virtually all types of metamorphic rocks. A need for chemical equilibrium independent thermobarometric methods and a growing evidence for mineral reaction overstepping promoted in-depth studies of quartz behavior as inclusion in stiffer phases such as garnet and associated strain and stress development as well as fostered common usage of trace element thermometers. On the other hand, less common coesite became the primary target phase in metamorphic studies tackling a problem of deep subduction of Earth's crust to mantle depths. A common routine to identify the latter mineral is to look for specific microtextures such as radial cracks around coesite inclusions in other minerals and/or characteristic pseudomorphs such as polycrystalline and palisade quartz. Subsequent confirmation of the presence of coesite with Raman spectroscopy and/or electron backscattered diffraction (EBSD) is needed. Therefore, we decided to look for (a) yet another way of quick identification of coesite, and (b) potential development of an alternative geothermobarometric technique applied to quartz and coesite. Here we report preliminary results obtained using acoustic microscopy, a vastly unknown technique in petrological community. Our preliminary tests on quartz monocrystals show that acoustic wave velocity depends on quartz orientation. However, the test on coesite and palisade quartz from Dora Maira shows that coesite reveals faster wave velocity than quartz regardless the crystallographic orientation. The latter is, in fact, not surprising since the method in question is primarily dependent on a density and elastic properties of the tested material. Nonetheless, to our knowledge an empirical test of this kind has not been done before. Thus, we can preliminarily conclude that the acoustic microscopy can be used as an alternative tool to quickly identify coesite. A development of a new thermobarometer would require a careful EBSD pre-study though. This obstacle together with limited access to acoustic microscopes in general may hinder this process. On the other hand, a use of acoustic impedance to image either growth and/or deformation zones in minerals or specific microtextures of multimineral systems appears to be especially advantageous.

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