Solid-state synthesis of silicates that tries to reproduce rhyolitic-xenolith interaction in the Monte Ulmus peralkaline pyroclastic unit (Sardinia, Italy)

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The Monte Ulmus unit is peralkaline pyroclastic rhyolite [1] placed in the upper part of the Miocene calk-alkaline volcanic succession (SW Sardinia). The lower part of the unit contains abundant xenoliths that can be related to the host rock into the upper part of the shallow magmatic chamber. Previous petrographic, mineralogical (XRD) and isotopic study [2] has shown that calk-silicate xenoliths came from the Lower Cambrian carbonatic platform of Iglesiente-Sulcis. At that stratigraphic level other constituents (mainly clay-rich and siliciclastic material from Precambrian and Lower Cambrian) are present. Different synthesis experiments were prepared to determine the conditions and reaction times of the pyrometamorphic paragenesis found in this unit. The tests were carried out in a solid state at 400-550-650-700-750-850ºC and atmospheric pressure, with relative proportions between the theoretical magma and carbonate rocks (1:1 to 1:05). The reaction times were from 12 to 504 hours and the natural and synthetic reactants proportions used (limestone, Tripoli, hematite, metakaolin (burnt at 700ºC), Na_2CO_3, KCl) were calculated stoichiometrically from the Monte Ulmus peralkaline rhyolite unit. In the paragenesis found at 400 and 550ºC, the amorphous silica has just reacted (cristobalite and quartz or exclusively quartz if it is a lower content of limestone). The runs at 650°C show the beginning of the Vesuvianite formation. At 700°C wollastonite, vesuvianite and diopside were formed. Runs at 750°C show the gradual replacement of quartz with tridymite. Finally, run at 850°C to show the persistence of quartz-wollastonite with minor proportions of amorphous phases. All these experiments are in good agreement with published data and are in a broad sense compatible with short reaction times and natural paragenesis.

[1] Gisbert & Gimeno (2017) Geol. Magazine 154 (4): 740-756. [2] Carrazana, Novembre & Gimeno (2018) Geogaceta 63: 103-106.