

Garronite-Ca, analcime, and phillipsite-Ca in the Barranc Salat ophite quarry, Calpe, Alicante, Spain

Miguel Calvo

Introduction

About 2.5 km west of the town of Calpe, about 300 meters NE of the confluence of Barranc Salat and Barranc de la Mola, on the west slope of a 200 meter high hill, there is an excavation dating back to the 1960s in which a type of ophitic rock was extracted. The eruptive rock, probably from the Triassic, forms an olistolite in a complex olistostromic terrain of Langhiense age (Middle Miocene). The ophite is quite altered, with abundant fractures filled or coated by minerals of hydrothermal origin, mainly calcite and zeolites. The objective of this paper is to describe this secondary mineralization.

Analcime $\text{Na}(\text{AlSi}_2\text{O}_6) \cdot \text{H}_2\text{O}$

Analcime is a quite common zeolite in this locality, having being known from here for quite some time (Calvo, 2018). It appears as colorless or white crystals, transparent or translucent, generally between 3 millimeters and 1 centimeter size, forming isolated individuals or, more frequently, as associations of

a few interpenetrating crystals, which makes the fracture surfaces have a radiated appearance. Their faces correspond to the trapezohedron $\{211\}$, which is the only one in some cases, associated with the cube $\{100\}$ which, although it never becomes dominant, can reach significant size.

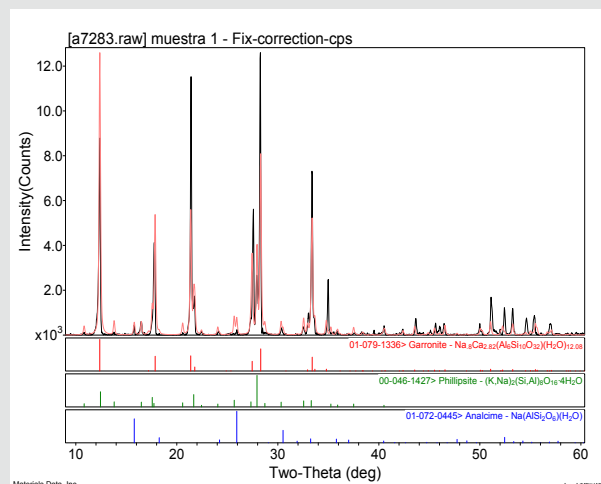
Garronite-Ca $\text{Na}_2\text{Ca}_5\text{Al}_{12}\text{Si}_{20}\text{O}_{64} \cdot 27\text{H}_2\text{O}$

Garronite is a zeolite found at multiple localities in both County Antrim, Northern Ireland, and Fásskrúdsfjörður, Iceland (Walker, 1962), but elsewhere in the world seems to be relatively rare. It almost always appears as compact radiated aggregates, usually zoned concentrically, filling vacuoles totally or partially, without exhibiting individual crystals. When the filling is incomplete, the surface layer usually consists of phillipsite (Tschernich, 1992). Until recently, all the specimens described had Ca as the dominant exchangeable cation, but recently Garronite-Na was found at Mont Saint-Hilaire, Quebec (Grice *et al*, 2016), so the

Garronite-Ca crystals in oriented growth, associated with groups of interpenetrating analcime crystals. Barranc Salat, Calpe, Alicante. Biggest analcime group 7 mm. Miguel Calvo collection.



X-ray diffraction spectrum of the garronite (black) together with the standard spectrum for this zeolite (red) and the principal peaks of garronite (red), phillipsite (green), and analcime (blue).





Garronite-Ca crystals in oriented growth. Barranc Salat, Calpe, Alicante. Height of group 11 mm. Miguel Calvo collection. Joaquim Callén photos.

current correct nomenclature for specimens with calcium dominating is Garronite-Ca.

In the Barranc Salat quarry, garronite-Ca has been found as aggregates that can exceed one centimeter size, formed of white crystals, which are quite fragile. The garronite was identified by X-ray diffraction, and its composition determined (with calcium as the dominant exchangeable cation) by X-ray

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fluorescence, carried out at the General Service of Research Support at the University of Zaragoza. The crystals of Garronite-Ca are markedly striated, and form aggregates similar to those found in San Giorgio di Perlina, Fara Vicentino, Vicenza (Italy). Crystals from this locality are formed by combinations of {101}, {011} and {112}, with the striations on the {112} faces being parallel to [11 $\bar{1}$], which has been attributed to the existence of twinning on (1 $\bar{1}0$) (Howard, 1994). There are also twins on {011}, which give rise to the defined crystal groups. It is possible that epitaxial growth on previously formed phillipsite crystals also participates in the formation of these groups (Howard, 1994). The Barranc Salat garronite-Ca is directly associated with the analcime crystals, just like in San Giorgio di Perlina (Passaglia *et al.*, 1992), being of later formation. It also appears on crusts of calcite microcrystals, although in some cases the calcite microcrystals are younger. In both locations phillipsite has been found within the aggregates of garronite-Ca.

Until now, the presence of garronite in Spain had been reported only occasionally as fibers observable by BSE (backscattered electron microscopy) associated with gobbinsite that fills cavities in the dolerite that forms a laccolith in the Sierra de San Pedro, Jaén (Jiménez Millán *et al.*, 2007). This laccolith is located to the south of Los Chopos, in the municipality of Castillo de Locubín. The aggregates of crystals from the Barranc Salat quarry can be considered among the best in the world for this species, together with those of the Italian locality mentioned above.

Other minerals

Phillipsite-Ca is apparently quite scarce at this locality, although it is found inside the aggregates of garronite, as can be seen in the X-ray diffraction patterns. Calcite, on the other hand, is very abundant, forming crusts of microcrystals that completely cover the walls of the fissures. It is also occasionally found on the garronite.

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Miguel Calvo
calvoreb@unizar.es