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ABSTRACT

The doctoral dissertation concers the larimar, which is one of the mineral wealth of the Dominican Republic. Although this term does not exist in mineralogical and petrological nomenclature, it has been established in the minds of people and mass media as a decorative stone, with unique ornamental qualities.

Larimar has gained recognition thanks to its unique colours and complicated structural and texture features, which are associated with the various forms observed on its surface. As a result these forms create a unique larimar pattern.

Available information, accessible in the literature about this stone has mainly focused on basic mineralogical and petrographic data, especially its chromophores. Despite many years of research in this field (the first article published in 1989) this problem has not been solved yet. Driven by curiosity as well as the desire to broaden knowledge about the unique mineralization, the author has taken on the task of solving the issues using various analytical methods. These are: microscopic observations using stereoscopic, polarizing in transmitted and reflected light microscopye, scanning electron (SEM-EDS) microscopye, Raman microspectroscopy (RS), Fourier-transform infrared spectroscopy (FT-IR), UV-VIS-NIR spectroscopy, X-ray diffraction analysis, thermogravimetric analysis (TGA) and electron-probe microanalysis (EPMA).

Larimar is an example of complex mineralization, in which the main component is a pectolite and the other minerals (calcite, natrolite, prehnite, clay minerals (chlorite, chlorite/smectite), apatite, hydrogarnet, native copper, as well as graphitelike carbon material) are accompanying phases. This composition is also well reflected in the structure of PhD thesis, i.e. its main part (approx. 70% by volume) was devoted to detailed studies of pectolite (Chapter 5) and then different minerals coexisting with pectolite (Chapter 6) and bedrocks (Chapter 7) were described. In Chapter 8, petified (pectolitized) tree fragments (trunks, branches) were characterized. The latter are found within basic (basalts) and pyroclastic rocks (volcanic breccia, tuffs) in larimar deposit, located in the section of Los Checheses, in the Sierra de Bahoruco mountain range.

On the basis of varying structural-textual features and mineral composition, the first larimar classification was proposed in the thesis. Two types of larimar were distinguished, i.e. centric (C) and non-centric (NC), including 7 subtypes (structural classes).

While conducting detailed laboratory studies on pectolite, the special attention was paid to the variability of its colour shades (from white, through green to blue) as well as the degree of colour saturation. The UV-VIS-NIR data showed that Cu^{2+}, Fe^{2+} and not excluded also Fe^{3+} ions are probable chromophores whose changing concentations create specific colour tones and colour saturation. The variability of physical parameters (e.g. hardness/compactness) of different pectolite colour varieties, as well as slightly developed microporosity of white pectolite, in comparison to other colour varieties, were also observed. These data correlate with observed increase in the number of hydroxyl groups and their variable position in the white pectolite structure. Thermogravimetric data showed that water molecules in the structure of pectolite are bound in different ways, depending on the colour variety. Moreover, the differences in the strength of O-H groups bonds in particular colour varieties of this silicate were observed.

The lattice parameters and angular values of the blue pectolite unit cell determined by X-ray analysis, differ significantly from the cell parameters of the standard pectolite (ICDD No. 33-1223) and other coloured varieties of this mineral from the Los Checheses deposit. Some slight differences in the chemical composition of pectolites are observed. In the green and deep blue pectolites, an increased content of Al_2O_3 compared to the white and light blue pectolites is observed. This regularity is visible in the crystal chemical formula of pectolites:

blue pectolite → $Na_{0.96-1.01}Ca_{1.98-2.05}(Si_{2.98-3.0})O_8(OH)$
green pectolite → $Na_{0.95-1.00}Ca_{1.99-2.04}(Si_{2.98-3.0}Al_{0.01-0.02})O_8(OH)$

Pectolite mineralization occurs in strongly altered basic rocks (basalts) which are crosscut by dolerite dikes and pyroclastic rocks (volcanic breccia, tuffs). These rocks are part of the large complex of the Dumisseau Formation (marine?), which belongs to the volcanic province (CLIP).

A unique phenomenon observed in the examined samples is the presence of pectolite mineralization in the fossil fragments of trees and fruits. Initially, the plant tissue was carbonized under anaerobic conditions. In the next stage it was impregnated by minerals such as: calcite and pectolite and occasionally prehnite and chlorite, as a result created subsequent, interesting structural class of larimar, i.e. the breccia, organic type (NCB-1).