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NEW DATA ON EMERALDS FROM PANJSHIR VALLEY, AFGHANISTAN

INTRODUCTION

Emerald deposits occur in the Panjshir valley of the Kapisa District in the Parwan Province (34°50’20”N; 70°50’30”E) in Afghanistan. They include 7 mining areas located on southern slopes of the Hindu Kush between Darkhenj and Riwat – two tributaries of the Panjshir River. Gem-quality emeralds occur in calcareous rocks (Riwat area) and more rarely in Palaeozoic schists (Easter Henj, Mikeni and Darun areas). Main occurrence of the Henj emeralds is built of folded marbles and phyllites cut by Permian-Carboniferous diorite dykes. Emeralds are usually found in the dykes cut by numerous veinlets of iron and magnesium carbonates. They favour places where the veinlets cross each other and are mainly associated with ankerite, dolomite, albite, rock crystal and pyrite. The emeralds from Panjshir deposit are rather small, 5-15 mm long and 2-5 mm thick, deep green (Kiyerlenko, 1982). Prevailing form of the crystal is a hexagonal prism of the 1st type {1010}.

The Panjshir emeralds characteristically host beryl-, limonite-, pyrite-, feldspar- and fluid two- and multiphase inclusions. Two-phase inclusions consist of water and gaseous phase and multiphase ones contain even up to 8 minerals. Apart from saline brine, carbon dioxide and aqueous vapour, they may host euhedral crystals of halite, sylvite, lawrencite as main solid phases with minor amounts of Ca-Ba chlorides. Multiphase inclusions are characteristic of the Panjshir emeralds, especially due the presence of sylvite inclusions which are absent in emeralds from other localities (Zylberman, 1998, Vapnik and Moroz, 2001). The investigations of Vapnik and Moroz (2001) show that the salinity of the fluid inclusions is high (more than 80-90 wt.%) and the temperatures of inclusion trapping was about 400˚C.

Four crystals of the Panjshir emeralds were investigated. They are deep green hexagonal prisms, 4 mm long, with a diameter of 2 mm. Refractive indices are ne=1.582 and no=1.588.

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OXYGEN ISOTOPE STUDIES

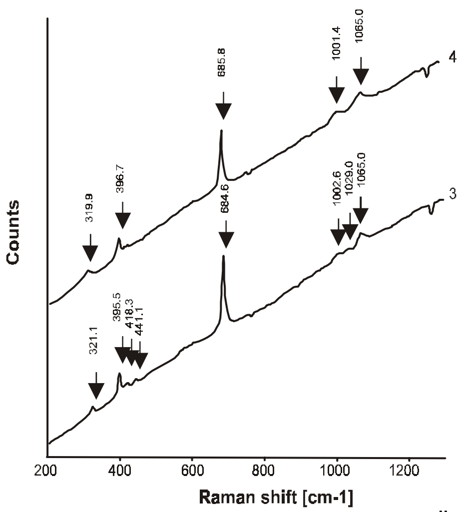
In recent years oxygen isotope studies have become an important tool in research on emeralds. They provide much information about the origin of crystals. The results are expressed as δ18O [‰] in relation to the SMOW international standard. Analysis of emeralds from 62 deposits in 19 countries showed that δ18O ranges from 6.2 to 24.7‰ (Giuliani, 1998). Giuliani (1998) distinguished 3 types of emerald deposits according to δ18O values. First type, with δ18O<8‰, comprises deposits in Australia, Austria and Quadrilatero Ferrifero region in Brazil. Emeralds occur here within biotite schists and metaamphibolites. Second group includes deposits in Madagascar, Pakistan, Russia, Tanzania, Zambia, Zimbabwe and Brazil (Carnaiba and Socoto) and shows δ18O values from 8 to 12‰. Gems from those localities are found in phlogopite and talc-chlorite-carbonates schists. The last type with δ18O>12‰ comprise occurrences in Afghanistan, Brasil (Santa Terezinha de Goias), Columbia and Pakistan (Swat-Mingora). Emeralds from those deposits occur in dark grey carbonate schists, talc-carbonates schists, talc-magnesite schists and carbonate rocks.

The isotope studies of two Panjshir emeralds were carried out in the Laboratory of Isotope Geology and Bioecology, University of Wrocław by means of the laser ablation technique (Jędrysek and Weber-Weller, 2000) with the standard analytical error equal 0.1‰. In the investigated Panjshir emeralds δ18O equals 10.2‰ and places them in the second group of deposits in the Giuliani's scheme (1998).

RAMAN MICROSPECTROSCOPY

The Raman spectra were measured on Jobin-Yvon T-64000 spectrometer, using Argon laser (λ=514.5 nm) at the Department of Molecular Physics, Technical University Łódź. Gem-quality emeralds with no inclusions detectable under optical microscope were analysed in several points both ║c and ⊥c (Fig. 1 and 2).

Peaks obtained from crystals oriented ⊥c are stronger, with the most intensive signals at 1068.4 cm-1 and 682.6 – 684.4 cm-1. In the spectra ║c only the band about 685 cm-1 appears as a strong peak. In the spectra of the Panjshir emeralds, along with the bands characteristic of emeralds, there appear also weak peaks from inclusions (Fig. 3): anorthite, albite, zircon, garnet, CO2, halite, graphite (peak 1592.0 in Fig. 2) and siderite (peak 1134.7 in Fig. 2).



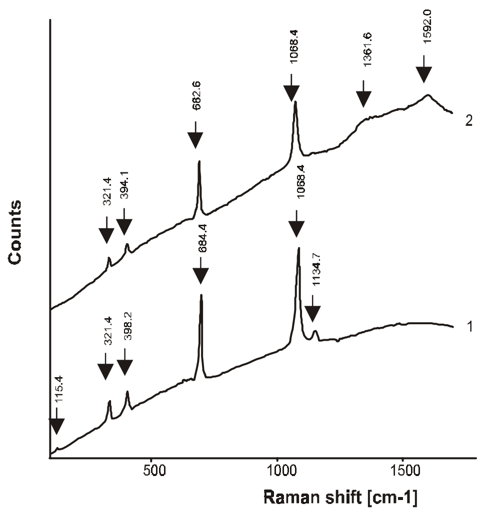


Fig. 1: Raman spectra of Panjshir emeralds ║c.Fig. 2: Raman spectra of Panjshir emeralds ⊥c.

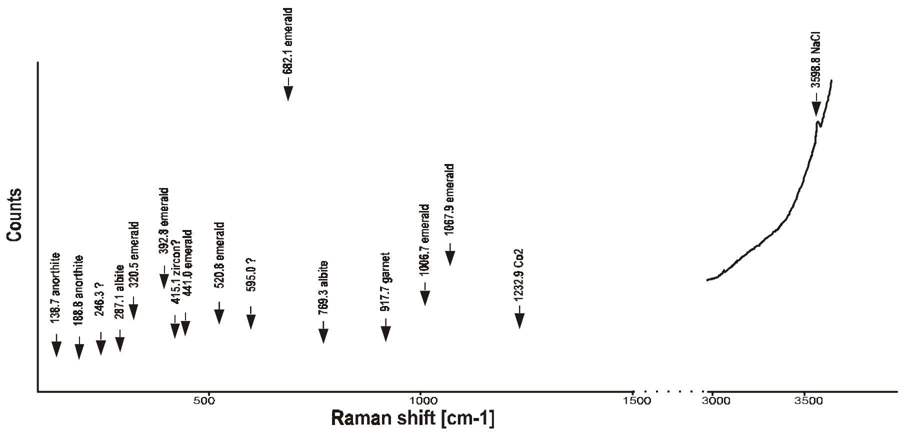


Fig.3: Raman spectrum of a Panjshir emerald ⊥c.

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