
Solid and Fluid Inclusions-Data of Colombian Emeralds

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Partial results of an ongoing research on the origin of the Emeralds of Colombia are presented. The deposits are confined along two belts on the eastern and western flanks of the "Cordillera Oriental" near Bogotá, Colombia.

Colombian Emerald Samples from Muzo, Yacopí, Pacho, Coscuez and Chivor have been submitted to SEM/EDS (Scanning Electron Microscopy/Energy Dispersive Spectrometry) analyses of their solid and fluid inclusions. The solid inclusions are pyrite, calcite, apatite, quartz, rutile and emerald. Additional analyses by X-ray diffraction indicated calcite, dolomite, magnesite, and clay minerals. In the fluid inclusions the SEM/EDS analyses of daughter minerals and evaporation products of saturated aqueous phases indicated respectively halite, sylvite, calcite and Ca^{++} , K^{+} , Na^{+} , Cl^{-} -ions.

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The detected solid inclusions permitted the characterization of emeralds from those deposits, indicating in some instances a simultaneous crystallization of the host and the included minerals. The results also brought additional information on the ionic composition of the mineralizing aqueous fluids.

Most studies in the past concentrated on one or the other deposit only. Here, fluid inclusion studies on a total of five deposits (Muzo, Pacho, Yacopí, Coscuez and Chivor) with altogether 450 fluid inclusions (FI) studied complement the existing data.

The most important finding of the microthermometric measurements is that all FI from all deposits showed PARTIAL homogenization by vapor disappearance before TOTAL homogenization by salt dissolution (Halite at Muzo, Pacho, Chivor and Coscuez, but Sylvite at Yacopí). The temperatures of partial homogenization are $210 \pm 30^{\circ}\text{C}$ and

those of total homogenization $330 \pm 30^{\circ}\text{C}$. Emeralds from Chivor showed slightly higher temperatures of $370 \pm 30^{\circ}\text{C}$. These results reconfirm data given by OTTAWAY *et al.* (1986), from Muzo and by GIULIANI *et al.* (1992), from Coscuez, but not those given by KOZŁOWSKI *et al.* (1986), from Somondoco.

As a first approximation of the complex chemistry of these fluids, the data are displayed in the model systems CaCl_2 - $\text{NaCl-H}_2\text{O}$ and CaCl_2 - $\text{KCl-H}_2\text{O}$ respectively. One notes very high salt concentrations of about 40 to 50% by weight for all deposits.

Minimum pressures of sealing of these FI are estimated by the method SOLOVAYA *et al.* (1992), in model system $\text{NaCl-H}_2\text{O}$ using the difference of temperature between the vapor disappearance and salt dissolution. Pressures determined this way are independent from any estimated thickness of former overburden based on the geological history. Since the system $\text{NaCl-H}_2\text{O}$ shows a quite high vapor pressure along the Liquid (L)- Solid (S)- Vapor (V) coexistence curve and the slope of the halite dissolution (L+S/L) curves should not be strongly dependent on the presence of other dissolved ions, the pressures so estimated may very well be maximum pressures of closing and formation of those FI. The values found define a mean of about 1200 bars. It is therefore likely that the mean conditions of the formation of the FI's and consequently of the emeralds are about 330 to 370°C and about 1200 bars pressure.

This pressure translates to about 5 km of former overlying rockstrata at the time of formation of these emerald deposits and, if one considers the lithostratigraphy of the "Cordillera Oriental" as shown by DENG & COVEY (1993), appears reasonable.

REFERENCES

- DENGO, C.A. & COVEY, M.C. (1993): Bull. AAPG, 77, 1315-1337.
- GIULIANI, G.; SHEPPARD, M.F.; CHEILLETZ, A. & RODRIGUEZ, C. (1992): Compte Rend. L'acad. SC. (Paris), 314, 269-274.
- KOZŁOWSKI, A.; METZ, P. & ESTRADA, H.A.J. (1988): N. Jb. MIN. Abh., 159, 23-49.
- ORDOÑEZ, F.H.R.; SCHULTZ - GUTTLER, R.A. & SUISERO, P. (1994): 16th General Meeting International (Pisa).- Mineralogical Association, P.310.
- OTTAWAY, T.L.; WICKS, F.J. & SPOONER, E.T.C. (1986): Fluid Inclusion Research, 19, 322.
- SOLOVAVA, I.; GIRNIS, A.; GRUZKOVA, A. & NAUMOV, B (1992): Geochem. Intern., 29, 64-74.

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