EVIDENCES OF COMPRESSIVE STRUCTURES IN THE MUZO AND COSCUEZ EMERALD DEPOSITS, EASTERN CORDILLERA OF COLOMBIA

Yannick BRANQUET (1), Bernard LAUMONIER (2), Benoît LOPES (3), Alain CHEILLETZ (4,1), Gaston GIULIANI (5,1) and Felix RUEDA (6)

(1) CRPG-CNRS, BP 20, 54520 Vandœuvre-lès-Nancy, France
(2) EMN-INPL, 54042 Nancy cedex, France
(3) BRGM, PO BOX 1492, JEDDAH, 21431KSA, Arabia Seoudita
(4) ENSG-INPL, BP 452, 54001 Vandœuvre-lès-Nancy, France
(5) ORSTOM, 213 rue La Fayette, 75480 Paris cedex 10, France
(6) MINERALCO S.A., calle 32, No 13-07, Santafe de Bogotá, Colombia

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INTRODUCTION

This paper presents the results of structural studies (Branquet, 1995; Lopés, 1995) realized on two major emerald deposits of Colombia located in the western border of the Eastern Cordillera (EC) (Fig. 1). These studies have been motivated by the recognition of the sedimentary-hydrothermal origin and the syn-tectonic nature of the mineralization in the eastern border of the EC (mining district of Chivor) (Giuliani et al., 1992; Giuliani et al., 1995; Cheilletz and Giuliani, 1996). A new tectonic model emerges from this study.

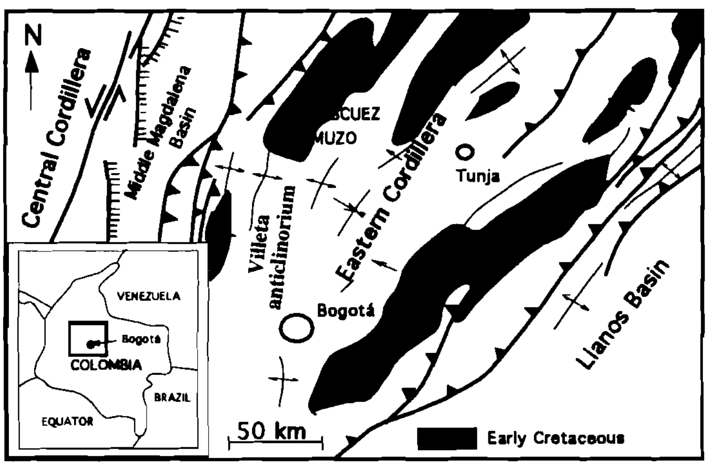

Figure 1. Location of the Muzo and Coscuez emerald deposits in the Villeta anticlinorium in the EC (Schamel, 1991, modified).

GEOLOGICAL SETTING

Between subduction-related Western and Central cordilleras and the Llanos foreland, the EC is supposed to have originated in the inversion since Upper Miocene (except for Middle Eocene folds, Cooper et al., 1995) of a Triassic-Paleogene basin, with development of thrusts, ramp folds and reverse faults verging eastwards over the Llanos foreland but also westwards over the middle Madgalena basin (Colleta et al., 1990; Dengo and Covey, 1993; Roeder and Chamberlain, 1995). In the west of the EC, emerald deposits are hosted within the lower part of Early Cretaceous series, which cores kilometric scale anticlines forming the Villeta anticlinorium (Fig. 1). The formations outcropping in the deposits are, from bottom to top: (i) dolomitic limestones (at Coscuez only); (ii) carbonated black shales (CBS), hosting the emerald mineralization; (iii) siliceous black shales (SBS); (iv) argilites.

THE COSCUEZ DEPOSIT

A N35°E trending fault (Coscuez fault) separates a western domain characterized by thrusts (or reverse faults) and ESE-ward vergent N25°E folds, from an eastern one (including the mine) presenting a main thrust (Coscuez thrust) superposing SBS and CBS units. The eastern domain shows E-W, northward vergent, horizontal folds and thrusts with white hydrothermal tectonic breccias (HTB) cemented by carbonates and pyrite, younger N-S folds and N30°E cleavage. The Coscuez thrust is outlined by a HTB and cuts the E-W folds. In the Coscuez mine, thrusts are proved by greatly truncated strata and the presence of an HTB. Two deformational events are recognizable: (i) a NNE-ward vergent D1, especially in the eastern domain (firstly E-W folds and lastly Coscuez thrust); (ii) a ESE-ward vergent D2 presenting N25°E folds, especially in the western domain. The Coscuez fault, outlined by a HTB, acted firstly as a tear senestral fault during D1 and then as the reverse fault during D2, when the western domain moved moderatly onto the eastern one.

THE MUZO DEPOSIT

The Muzo deposit is exploited in two mines: the Quipama mine on the southside of the N135°E trending Itoco fault and the Tequendama mine on the other side. The Muzo deposit is mainly characterized by thrusting which is demonstrated by CBS over SBS superposition, HTB, and truncated strata.

The Quipama mine have a complex structure in which the 3D geometry of the tectonic units limited by thrusts, can be precisely described. According to this geometry, using folds as kinematic indicators and establishing a chronology based on the folding of thrusts, two deformational events can be identified: (i) D1, characterized by N130°E folding and thrusting which presents a N30°E transport axis (vergency undeterminated); (ii) D2, characterized by ESE-ward folding and thrusting.

At Tequendama, the same D1 and D2 structures occurred, but a D3 event has deeply reworked them. The D3 event is marked by the development of a red HTB (cement of ankerite). D3 is also characterized by an hectometric scale NW-ward vergent fold and a reverse fault. Relatively to D2, D3 was a backthrusting and backfolding event linked to the Itoco fault which was clearly a senestral tear-fault. During these three phases, first thrusts can be folded by a later phase, they can also be reactivated with a different transport axis.

DISCUSSION AND CONCLUSION

If a duplex is defined by an array of thrust horses bounded by a floor thrust at the base and by a roof thrust at the top (McClay, 1992), the emerald deposits are two -or (at Tequendama) three-phase duplexes which have induced structural highs determinated by NNE-SSW and NW-SE lineaments, hence the limited extend of the CBS and emerald mineralization, except northwards at Tequendama; hidden structures probably exist that seem worth being prospected. The three deformational events were associated with an hydrothermalism (responsible for emerald precipitation) which generated under-compacted levels and enhanced high rate deformation (thrusts) besides the low rate one which produced folds and cleavages.

The age of the tectonic phase is the same as the radiometric age of the hydrothermalism: Cheilletz et al. (1994) determined for the Coscuez and Muzo deposits an Upper Eocene-Lower Oligocene age, respectively 38 Ma and 32 Ma. Motion is parallel to the trend of the EC (NNE-SSW) during D1. During D2 and D3 the motion is orthogonal to the EC global trend, the change of transport direction between D1 and D2-D3 is not explained yet, as is the age itself which is older than the supposed age of the chain formation (Middle-Upper Miocene). These results should be accounted for in any reappraisal of EC genesis.

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