

## Cenomanian-Turonian bentonites of the Eastern Cordillera and Upper Magdalena Valley, Colombia

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The Cenomanian-Turonian marine sediments of the Eastern Cordillera and the Upper Magdalena Valley, Colombia, record a sequence above basal transgressive surface (Upper Cenomanian), a deepening trend corresponds to the evolution from a transgressive to a highstand systems track (Middle to Upper Turonian). These sediments are intercalated with possible bentonite horizons (e.g. Villamil & Arango, 1998) that are used as markers for stratigraphic correlations in the Cretaceous basin. However, the volcanic origin of these layers remains equivocal.

The suspected ash layers are completely altered and are normally in clay facies. Al<sub>2</sub>O<sub>3</sub> concentrations reach up to 30 wt.%, and MgO concentrations are less than 1.5wt.%, indicating strong leaching and a probable relative enrichment in immobile elements. Chondrite normalized REE pattern show La<sub>n</sub>/Yb<sub>n</sub> ratios from 2 – 15 and extreme negative Eu anomalies. These Eu anomaly may be the result of REE-mobilization under the reducing conditions in the basin, which is consistent with the abundance of pyrite. Sr and Nd isotopic signatures reveal strong crustal contributions (<sup>87</sup>Sr/<sup>86</sup>Sr: 0.71645-0.72126). Normalization to North American Shale Composition (NASC) and to adjacent black shales suggest that sedimentary protoliths are unlikely although clastic sediments are likely contaminants of the bentonites.

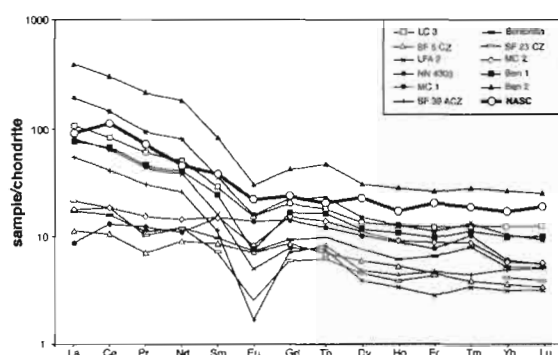


Fig. 1: Chondrite-normalized REE concentrations of the bentonites and NASC

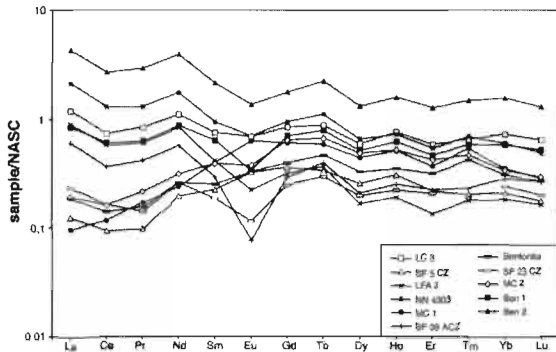


Fig. 2: NASC-normalized REE concentrations of the bentonites

The attempt to recalculate the original chemical composition by immobile element ratios and mass balance indicate probable magmatic precursors of basaltic to andesitic or dacitic composition. Although fractionation of possible ashes by aeolian transport or water settling or mixing with enveloping detrital shales must have affected the original chemistry, the calculation points to probable low Nb and Ti concentrations and low Ti/Zr ratios of the original ashes. Therefore, an interpretation of the suspect bentonites as tephra derived from an orogenic setting or magmatic sources low in high field strength elements is likely. However, during Cenomanian and Turonian times a possible volcanic arc is several hundreds of kilometers west of the studied localities. In addition, the comparison with modern arc analogues (volcanics of the NVZ) and Cretaceous rift-related intrusive rocks of the Eastern Cordillera (e.g. Vásquez et al 2004), that rift-related magmatism cannot yet be excluded as the source.

**References**

Villamil, T. and Arango, C. (1998): Integrated stratigraphy of latest Cenomanian and early Turonian facies of Colombia. SEPM, Spec.Publ.58:129-159

Vásquez, M., Altenberger, U. and Romer, R.L. (2004): Rift-related Mid.Cretaceous magmatism in the Eastern Colombian Andes. Eur. J. Mineral. 16, Beih.:150.