

Lithofacies of very fine sand are characterized by high concentration in zirconium, barium, chromium and copper. Boron is present in low concentration but always appears. High values of TiO<sub>2</sub> are present and niobium is scarce, but highly concentrated in these samples. Values of gallium and cesium are similar to loessial samples. The silica average is 72.59 %.

Lithofacies of mud layers are characterized by a little height boron concentration. The values of zirconium, barium chromium and copper are high but minor than very fine sand values. Gallium and cesium are higher than very fine sand. The silica value is constant and differs from mudrock and very fine sand. They are the lowest (66.43 % average).

Lithofacies of mudrock layers are very similar to mud layers. However, significant differences in silica values mark the contrast (76.61 % average). Other study indicate that this lithofacies are tempestites (TORRA 2000).

These results shown clearly that different lithofacies can be geochemically recognized in this sequence. This fact should be very useful in order to identify underground beds in future drill-holes and regional correlation at the 'Chaco-Paranense intracratonic basin'.

TORRA, R. (1998): Estructuras sedimentarias marinas diagnósticas en las arenas de la Formación Ituzaiingó (Mioceno Medio), entre Itatí y Empedrado, Provincia de Corrientes, Mesopotamia de Argentina. - Revista del Instituto de Geología y Minería, **12** (1): 75-86.

TORRA, R. (1999): Ituzaiingó Formation. A Key for the Interpretation of the Upper Tertiary Stratigraphy, Mesopotamia-Chaco Paraná Basin, Argentina. - Revista Ciência e Natura. Universidade Federal de Santa Maria, Santa Maria. 'in press'

TORRA, R. (2000): Reinterpretación sedimentológica y edad de las Formaciones Paraná, Ituzaiingó, Toropí, Yupoí y Puelches (Mioceno medio), Mesopotamia de Argentina. - Revista Brasileira de Geociencias. 'in press'

### **Paleocurrents analysis in siliciclastic arenaceous sediments (sandy beach lithofacies) as a marker to paleoenvironmental systems, Northeastern Argentina**

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The Ituzaiingó Formation Sands is a significant sedimentary unit that scarcely outcrops in ravines and gullies near the Paraná river at the northeastern Mesopotamia region of Argentina. Several researchers studied it since 1848 to 1995. They concluded, upon paleontological basis, that the sandy-muddy lithofacies are of fluvial origin and Pliocene to upper Pleistocene in age. The fossils used as an indicator are of broad biochron, overall Cenozoic age. Two unconformities were proposed both on top and bottom of this unit, without determine exactly its potency (HERBST 1971, HERBST & SANTA CRUZ 1985, 1995, JALFIN 1988).

Recent studies concluded that none unconformities are present. The contact between sand and mud is conformable, resembling a lithofacies change. Fossil fauna is not representative and contacts were not observed until the present study (TORRA 1997a, b, 1998a, h, c).

I made, since 1994 to 1999, a detailed sedimentologic study about paleocurrents (over 450 measurements) on the planar cross stratification and tangential-sigmoidal cross-stratification, which are always present in the sandy lithofacies, both ferricretized (reddish) and non ferricretized (white) ones plagued of diagnostics internal intertidal-to-subtidal structures.

I found it a repeated simple and unequivocal bimodal bipolar design along more than 1,000 km at the Mesopotamia region, Northeastern Argentina. Recent bibliography, accept that bimodal bipolar design indicates more than one direction of the flow currents (i.e. reversal

flows as tidal currents). Previous studies considered these sediments as deposited like a fluvial system (i.e. a "braided platee" in JALFIN 1988).

After the study of the design of the paleocurrents roses, I proposed a shallow marine intertidal to subtidal environment system for these sandy-muddy sediments, roughly 230 meters in thickness at depths. This was texturally study by means of logs of most hydrogeologic drill-holes (TORRA 1999).

The age proposed is Middle Miocene synchronous with the 'Paranense Sea transgression deposits' (RASÄNEN et al. 1995, TORRA 1997a, b, 1998a, b, c, 1999).

HERBST, R. (1971): Esquema estratigráfico de la Provincia de Corrientes, República Argentina. - Revista Asociación Geológica Argentina, **24** (2): 221-243.

HERBST, R. & SANTA CRUZ, J.N. (1985): Mapa Litoestratigráfico de la Provincia de Corrientes. - D'Orbignyana, **2**: 1-51.

HERBST, R. & SANTA CRUZ, J. N. (1995): Mapa Geológico de la Provincia de Corrientes. 1: 500.000. - Ed. por Secretaría de Minería. Dirección Nacional del Servicio Geológico, Ministerio de Economía y Obras y Servicios Públicos, Buenos Aires.

JALFIN, G. (1988): Formación Ituzaiingó (Plio-Pleistoceno) en Empedrado, Provincia de Corrientes: un paleorrio arcuoso entrelazado tipo "platte". Actas. - II Reunión Argentina de Sedimentología, **1**: 130-135, Buenos Aires.

RASÄNEN, M. E., A. M. LINHA, J.C.R. SANTOS & F. NEGRY (1995): Late Miocene Tidal deposits in the Amazonian foreland basin. - Nature, **269**: 368-390.

TORRA, R. (1997a): Genesis and Age of the Ituzaiingó Formation Sands, Northeastern Argentina: a preliminary note. - 18<sup>th</sup> Regional European Meeting of Sedimentology, Abstracts, 339, Heidelberg.

TORRA, R. (1997b): Reconnaissance of Tidal Bundles by means of the Fast Fourier Transformations. Ituzaiingó Formation Sands (Miocene), Northeastern Argentina. - Memorias. I Congreso Latinoamericano de Sedimentología, **1**: 315-321, Isla de Margarita

TORRA, R. (1998a): Architectural Analysis of the Ituzaiingó Formation Sands (Miocene), Northeastern Argentina, South America. - Geocongress '98, Geological Society of South Africa, 178-181, Pretoria.

TORRA, R. (1998b): A Brief Stratigraphy and Paleogeography of the Miocene Sea at the Mesopotamia Region, Northeastern Argentina, South America. - Geocongress '98, Geological Society of South Africa, 79-81, Pretoria.

TORRA, R. (1998c): Paleocurrent Analysis Applied to Resolve Depositional Environment System. The Case of the Ituzaiingó Formation Sands (Miocene), Corrientes Province, Argentina, South America. - 15<sup>th</sup> International Sedimentological Congress, 768, Alicante.

TORRA, R. (1998d): A New Age (Miocene) and a New Environment Depositional System for Pelitic Toropí and Yupoí Formations, Corrientes Province, Argentina, South America. - 15<sup>th</sup> International Sedimentological Congress, 767, Alicante.

TORRA, R. (1999): Avances en el conocimiento del Terciario Superior de la Llanura Chaco-Pampeana. - IV Reunión de Comunicaciones Científicas y Tecnológicas, Universidad Nacional del Nordeste, Actas, **VI**: 93-96, Corrientes.

### **Spatial relation between tempestites (typical non-tidal offshore sand bodies deposits) and beteroolithic succession in shallow marine littoral environment. The case of the Ituzaiingó, Toropí and Yupoí Formations (Middle Miocene), Northeastern Argentina**

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The Toropí and Yupoí Formations are stratigraphic units created in order to solve the presence of mixed silty-very fine sandy mud soft sediment beds (typical "mudrocks" as proposed by TORRA 1998a, 1999a, b). They are outcroppings in a large region of the Mesopotamia Argentina (about 117,000 km<sup>2</sup>), always overlying Miocene marine sediments (i.e. Ituzaiingó Formation). The