

structural relation between them is conformable, and none autoctonous fossil or microfossil remains were founded before 1999 into the Toropí and Yupofí tempestites Formations.

The Toropí and Yupofí Formations were interpreted as continental (fluvial) in origin long time ago (HERBST 1971, HERBST & SANTA CRUZ 1985). They argued the presence of vertebrate fossil fauna remains of Pleistocene to Holocene age (HERBST & SANTA CRUZ 1985). The Toropí and Yupofí Formations have a maximum thickness of about eight meters averaging four meters (TORRA 1998b, 1999a, b).

Recent studies proposed that those vertebrate fossil fauna remains are alloctonous (TORRA 1998a, b). The interpretation was that the fossil remains are always in surface layers and that they were swamped into mud beds on Holocene times (11,500 BP, TORRA 1998c).

The sandy-muddy Ituzaingó Formation is a typical heterolithic succession beneath these horizontal mixed silty-very fine sandy beds of flat-lenticular forms. The fact is that marine heterolithic succession (Ituzaingó Formation) and the supposed continental Toropí and Yupofí Formations layers are in a quite concordance (TORRA 1999b).

The origin proposed for Toropí and Yupofí Formation is non-tidal offshore sand bodies deposits (formerly very fine sandy-silty mud bodies) deposited under the action of marine storm currents (i.e. tempestites or marine storm deposits).

The geochemical signatures of eight mayor molecules and fifteen trace elements carried out on Ituzaingó, Toropí and Yupofí Formations, confirmed that the sequence is in a fully agree with previous sedimentological thesis (TORRA 2000a, b).

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### Petrographical characterization of the Ituzaingó Formation Sands (Middle Miocene), Northeastern Argentina

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The Ituzaingó Formation is a wide succession of sand and mud beds. They appear in the left margin of the natural slopes, ravines and gullies of the left margin of the Paraná and Paraguay rivers at

the Mesopotamia region.

The outcrops of the northern beds are extremely characterized by a predominance of a very fine, well sorted, white sands. They have several internal structures such as tidal bundles, reactivation surfaces, herringbone cross-stratification, rhythmic tidal beddings, flaser beddings and bipolar cross-stratification. The sequence has a very simple arrangement of sigmoidal pattern (TORRA 1998, 1999).

Twenty-nine selected samples were picked up from the Corrientes province outcrops' (northeastern Argentine). In this way, twenty-nine thin-polished sections were made out. They were studied using standard polarizing microscope methods.

The results show a great predominance of well rounded to rounded quartz grains in form, generally uniform in size and spherical appearance (0.15-0.06 mm in average). The percentage is over 95 % quartz. About 85 % are monocrystalline quartz grains with few visible fluid inclusions and not undulose extinction. The other 15 % were polycrystalline grain-sutured quartz grains (metamorphic grains?). Packing is largely cubic and highly porous. Neither cement nor matrix material is present into unaltered sand beds. Both, the very well sorting and rounded grains point out a 'superature' texture sand very frequent in beach environments. There are no significant quantities of feldspars and lithics grains. Very scarce microcline is present, generally characterized by cross-hatch twinning. The main translucent resistates minerals are tourmaline, muscovite, rutile, zircon, kyanite, staurolite, chalcedony and garnets.

Opaque minerals are mainly rounded magnetite grains, which is always present. Sometimes magnetite grains appear in quantities of about more than 3-5 in percentage. The significant ferritization processes are present in some of upper beds of the Ituzaingó Formation derived from magnetite oxidation. This phenomenon stamped typical reddish to yellowish tones into the sand layers. It is possible that forces of oxidation caused break out of pure quartz grains, which are fully cemented by ferric oxides. Ilmenite and titanomagnetite are inferred to be present based on significant geochemical anomalous values in titanium (TORRA 2000).

In accord with the classification of DOTT (1964), the arenaceous lithofacies of the Ituzaingó Formation may be classified as a 'quartz arenite'.

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### Holocene fluvial reorganizing drainage pattern at the right margin of the Paraná-Paraguay rivers, Northeastern Argentina

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The right margin of the Paraná-Paraguay fluvial valley is frequently run around for a most number of young, low volumes, incision rivers at the Chaco-Pampeana region.

The use of TM Landsat 5 images satellites (compositions 357, 457 and 375 with histogram equalization stretching enhancements) prove to be a very useful tool for examine the spatial distribution pattern of incipient meandering fluvial rivers.

Among them, two courses, the Pilcomayo and the Bermejo rivers, run about to the "Chaco-Pampeana" plain as typical "meandering" river model. This is a reflection about the flat relief and topography of the region and is related with the weather conditions (a very wet climate).

The sedimentary deposits of these rivers (the Pilcomayo river, the Bermejo river, tributary stream and minor courses) have not a great significance. In fact, these are almost non-existent and mainly they are re-worked sediments of the Upper Tertiary arenaceous sediments. So, they have very little erosional potential.

The deposits of these little rivers are mainly arenaceous lithofacies of fine to very fine sand grains. Grouped planar crossbeds, trough crossbeds stratification is frequent at the beds, in which sometimes, bipolar cross stratification appears. Solitary and grouped channels are common. The downstream accreted mesoform and macroform deposits aren't present and not recognized by now.

It is proposed here that the origin of these low volume courses of meandering design reorganization drainage are quite synchronous with the base sea level change occurred on the 3,000 and/or 6,000 years BP periods according with HAQ et al. eustatic curves (1998). The climatic change, varying from more dry toward more wet conditions at northeastern Argentina in the period mentioned above (TORRA 1998).

These age were accuracy tested upon <sup>14</sup>C dating over widely mollusks biofacies related with restricted recent marine transgression whose deposits are present at the entrance of the Río de la Plata estuary and adjoining areas as the coast-line of the Buenos Aires Province (CORTELEZZI & LERMANN 1969).

These brief reflections have the aims to bring forward some ideas about a theme absolutely obscured and never studied in the Chaco-Pampeana region with modern architectural and remote sensing techniques.

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### Can geochemistry help in stratigraphic problems? The case of the Ituzaingó Formation (Middle Miocene), Northeastern Argentina

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The Ituzaingó Formation sands are a very typical heterolithic succession of sandy-muddy beds that cover all the northeastern of Argentina and the southwest of the Paraguay Republic. The outcrops are of about 117,000 km<sup>2</sup> (TORRA 1999a, b).

However, recent study of texture in hidrologic drill-holes in the vast area, reveals that these sediments are quite common in the major portions of the 'Chaco-Paraná intracratonic basin'. The extension confirmed until the moment sound of somewhat 450,000 km<sup>2</sup> (TORRA 1999a).

The sandy lithofacies are characterized for a well sort, very fine grain, very well rounded and gray to white in shades. When reddish, they are ferricretized (epigenetic oxidation of magnetite and ilmenite).

Recent architectural studies over the sandy lithofacies, show a typical assemblage of internal structures that are diagnostics of a tide-dominated depositional environment.

Hummocky cross stratification, herringbone cross stratification, first and second order reactivation surfaces, tidal rhythmic beddings, flaser beddings, bipolar cross stratification, sigmoidal stratification and tidal bundles-beddings are present in all the outcrops (TORRA 2000a).

Typically, an erosion unconformity was proposed between the heterolithic succession and the mudrocks that overlies itself (HERBST 1971).

The trace elements study led to the interpretation that the mud beds that structurally cover in quite conformable arrange the heterolithic succession, has the same geochemical anomalies -or signatures- (TORRA 1999b, 2000b).

The overlying unit was generally interpreted as in erosion discordance (HERBST 1971) in despite of to not accept a simple lithofacies change.

Geochemical trace elements data analysis shows the same anomalies ('signatures') in the muddy lithofacies interleaving with very fine sands. All the mud beds analyzed had the same geochemistry anomalies. As a result, we interpreted them as formed under similar sedimentologic and environmental conditions.

Trace element proves to be a suitable tool in order to help to solve stratigraphic problems always together with architectural analysis at least in the case of the marine Miocene sequence of the Northeastern region of Argentina (TORRA 2000b).

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### Geochemical properties and origin of rich-iron manganese concretions in the Ituzaingó Formation (Middle Miocene), Northeastern Argentina

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In the upper beds of the Ituzaingó Formation sands are present outstanding rich-iron manganese concretions previously studied by CORTELEZZI et al. (1997). The Ituzaingó Formation is largely defined by a heterolithic succession composed for interleaved sandy-muddy lithofacies. The upper levels are characterized for a typical thin mudrock bed, 2-4 meters in thickness. In these beds, horizontally disposed, breccial rich-iron manganese concretions appear. They are about 10-40 cm in size (average). Predominant shape is coarser botryoidal or irregular. The main elongation axis is markedly in the sense of the stratification. That is horizontally arranged.

Two selected samples of the Empedrado village and the Arroyo El Sombrero river, were picked up from very well exposed outcrops. The selected samples were analyzed by the technique of