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LUDO FORMATION - A NEW LITHOSTRATIGRAPHIC UNIT IN QUATERNARY OF CENTRAL ALGARVE

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ABSTRACT: The non consolidated, mostly sandy posits of Central Algarve, loosely termed Faro-Quarteira sands, were lacking a stratigraphic setting. In order to permit a more objective approach to mapping of Upper Neogene and Post Neogene sedimentary series in this area, a new lithostratigraphic unit is proposed - The Ludo formation. The exact chronostratigraphic position of Ludo formation is still matter of discussion but existing data are pointing on Terminal Pliocene - Pleistocene age.

INTRODUCTION

The clastic sediments cropping on Neogene deposits E from Ribeira da Quarteira are known as "Faro - Quarteira sands" and ascribed to Pleistocene Period (Manupella et al., 1987). Faro - Quarteira sands are predominantly medium grain, feldspatic and are containing variable amounts of clay and iron oxides. The identical deposits situated W from Ribeira da Quarteira were defined as Plio-Pleistocene by Bourcart and Zbyszewski in 1940, but later their stratigraphic position were redefined as Miocenic by Antunes (1979) and termed as such on sheet 52 B of the geological map of Portugal 1:50000 (Rocha et al., 1989). They were described as Praia da Falesia silts and sands, Olhos de Água feldspatic sands and Olhos de Água fossiliferous conglomerate. The upper part of sedimentary sequence, though identical with Faro - Quarteira sands bears no name and through correlation with deposits yielding vertebrate fossils in Algoz (Antunes et al., 1986b) and Morgadinho (Antunes et al., 1986a) are ascribed to Middle Pleistocene.

The most recent 1 : 100 000 geological cartography of Portugal defined the age of the deposits E and W from Ribeira da Quarteira as Quaternary, but this modification was not backed by any new evidence.

The term Faro - Quarteira sands notwithstanding its merit of discerning a sedimentary unit, embraces in fact very heterogeneous deposits from lithological and probably chronological point of view, whose common feature is the presence of ferruginous pigments. This pigments derived either from eroded carst and/or weathering crusts on silicate rocks inland, were redissolved and redistributed throughout the sedimentary sequence and therefore can not be considered as reliable stratigraphic marker. However a careful sedimentological study backed by paleomagnetic and paleontological data of what is believed to be the terminal Neogene and Pleistocene (Boski et al., 1993b) sedimentary sequence of Central Algarve, allows us to propose a new lithostratigraphic scheme for this area.

MATERIALS AND METHODS

Grain size analyses were carried out by sieving the fractions coarser than 63 µm and by pipette analysis of the finer fractions, according to technique proposed by Carver (1971) and Tucker (1988). Desagregation when needed was done in ultrasound bath (Kravitz, 1966). Gravels and boulders were measured by means of micrometer. Iron oxides were removed through hot phosphoric acid leaching. For interpretation of granulometry Folk and Ward (1957) parameters was applied, for morphometry Powers (1953) visual scale and classification obeyed terminology of Shepard (1957). Heavy minerals were separated in bromoform and determined under microscope. Feldspars were separated in sodium politungstate (Mejdahl, 1985). The oriented aggregates of clay minerals were prepared according to method of Bish et al. (1989) and XRD analysed. Paleomagnetic analysis were carried out on oriented consolidated samples in supraconducting magnetometer after cleaning in alternated field.

THE LUDO FORMATION

The present proposal of formalization of the new lithostratigraphic unit which was informally denominated Ludo sands (Boski et al. 1993a) follows the procedure recommended by the North American Commission on Stratigraphic Nomenclature (1983).

Ludo Formation overlying with unconformity Jurassic, Cretaceous and Miocene rocks and in apparent continuity Olenos de Água (Pliocene?) sands may be observed in the coastal fringe of Central Algarve which lateral NW-SE extension is about 22 km and width 5km. The maximum thickness of sediments ascribed to Ludo Formation reaches 30m in the area of the same name and decreases towards NW. The stratotype locality (coded 610-C1-1 on 1:25000 topographic map) is situated on the left margin of Ribeira de São Lourenço, 8 km NW from Faro. The 30 m vertical section (fig. 1) is exposed due to commercial exploitation of the sands, consists exclusively of

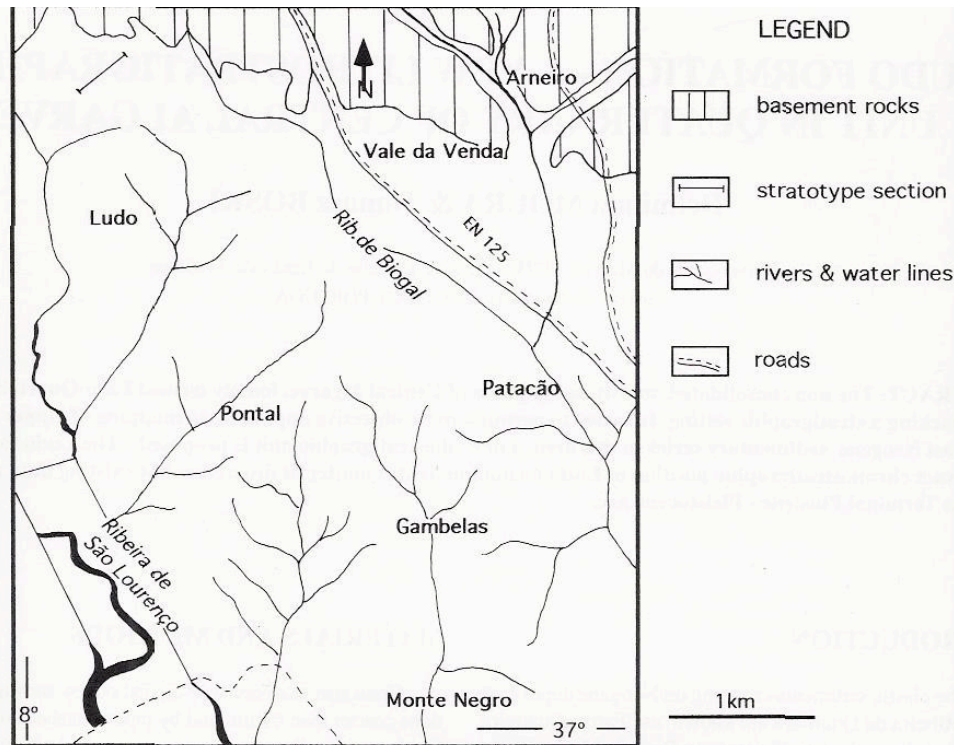


Fig. 1 - Localization of Ludo Formation stratotype

sandy sediments which granulometry is coarsening towards the top (fig.2).

Montenegro Sands member of the Ludo Formation

To this unit are ascribed the following strata from bottom to top:

A) White greyish (2,5 Y; 8/2) medium grain, moderately sorted sands. Besides the dominant quartz present as hialinic, subangular grains of low sphericity, other mineral components are:

- K feldspar partially kaolinized reaches 7% wt. mostly in 2.0 - 0.25 mm fractions
- muscovite varies from 0,5% to 0,3% in 0.063 - 0.25 mm and 2.0 - 0.25 mm fractions respectively
- heavy minerals are represented almost exclusively by ilmenite
- occasionally dark clayey nodules

Observed alternation of bioturbated and non disturbed levels. In the former two types of ichnofossils (Goldring,1991) were distinguished : a) sinusoidal, few centimetre long, 2 cm in diameter fodinichnia b) non classified (domichnia?) subvertical, up to 40 cm long tubular channels. The detrital remanent magnetisation (DRM) is normal. Total thickness is 2,5 m.

B) White creamy (2,5 Y; 8/4) fine grained, well sorted sands.

Besides the dominant quartz present as hialinic, subangular grains of low sphericity, other mineral components are:

- K feldspar partially kaolinized reaches 7% wt. mostly in 2.0 - 0.25 mm fractions

- muscovite present mostly in 2.0 - 0.25 mm fractions reaches 3% wt.

- heavy minerals, 0,5% wt are represented almost exclusively by ilmenite

Cubichnia ichnofossils are scarce and have their tours distinguishably marked by ferruginous pigment (DRM) is normal. Total thickness is 0.30 m.

C) White greyish (2,5 Y; 8/2) medium grain, well sorted sands. The dominant quartz is present as hialinic, rounded grains of low sphericity. Other mineral components are:

- K feldspar partially kaolinized reaches 6% wt. in 0.50 - 0.25 mm and 7% in 0.063 - 0.50 mm fractions
- muscovite constitutes 1.5% wt of total
- kaolinite constitutes 0,6% wt of total

The lamination, millimetric on base and centimetric towards top is conspicuous. The ichnofacies are identical to those described in A but the fodinichnia parallel to lamination are clearly predominant. The (DRM) is normal. Total thickness is 0.40 m.

D) White creamy (2,5 Y; 8/4) fine grained, well sorted sands. Quartz is present as hialinic, subangular grains of low sphericity. Other mineral components are:

- K feldspar accounts for 6% wt. in 0.50-0.063 mm fraction
- muscovite is 1.5% wt of total

- magnetite and ilmenite are 0,6% wt of bulk towards the top both concentrate in centimetric sandy laminae interbedded by reddish silty laminae. Domichnia ichnofossils are frequent as well as clayey nodules, probably ichnolasts. The (DRM) is normal.

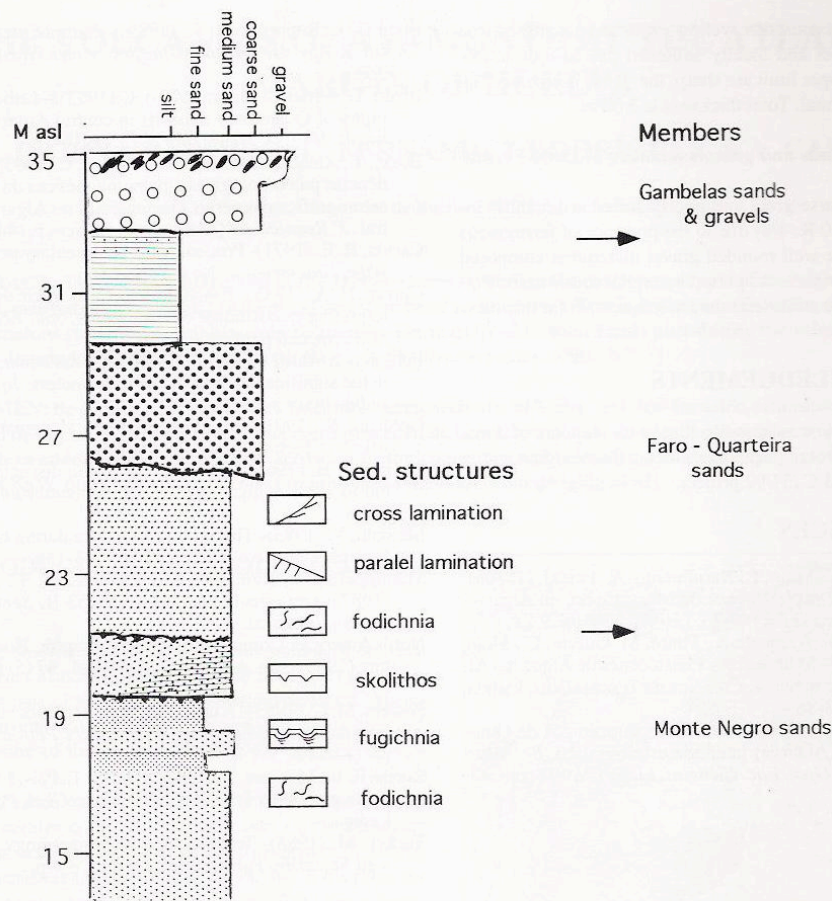


Fig. 2 - Lithological profile of Ludo Formation stratotype.

thickness is 3.00 m.

E) Yellow ochre (2,5 Y; 7/4) medium grained, moderately sorted sands.

Quartz grains are sub angular and of low sphericity

- K feldspar (kaolinized) accounts for 10% wt. in 0.50-0.063 mm fraction

- kaolinite constitutes 1,3% wt of total

The (DRM) is normal. Total thickness is 1.00 m. The contact with the overlying unit is conspicuously erosive.

Faro - Quarteira Sands member of Ludo Formation

For this sedimentary unit account subarctic medium to coarse grain sands and from base towards the top, following strata were distinguished:

A) Rose (10R; 5/6) to orange (5YR; 6/8) medium grain, well sorted sands. Rose sands exhibit horizontal stratification which truncates the inclined (5° S) lamination of orange sands.

- K feldspar (kaolinized) accounts for 20% wt. in bulk
- clayey component, kaolinite constitutes 5,7 % wt of total

The flame pattern and ball-and-pillow structures on contact with overlying strata is observed. The (DRM) is normal. Total thickness is 3.00 m.

B) White yellow (2,5Y; 8/4) medium grain, moderately sorted sands. Besides quartz.

- K feldspar (relatively fresh) accounts for 20% wt. in bulk

- kaolinite constitutes 8,3 % wt of total

Numerous sedimentary structures like ripples and cross lamination are observed. The topmost horizon of fine rose sand, rich in domichnia ichnofossils is truncated by overlying member. The (DRM) is normal. Total thickness is 3.00 m.

C) White greyish (2,5Y; 8/0) coarse grain, moderately sorted sands. Quartz grains may rich gravel size and form distinct layers

- K feldspar (fresh) accounts for 20% wt. in bulk

- kaolinite constitutes 8,3 % wt of total

Cross stratification as well as the gastropoda moulds are frequent. Total thickness is 4.00 m.

D) Arenaceous silts, yellow with red patches of iron oxy/hydroxides and locally whitened due to root action. Lower and upper limit are sharp, the latter is erosive. The (DRM) is normal. Total thickness is 3.00 m.

Gambelas sands and gravels member of Ludo Formation

These coarse grain and poorly sorted sediment is intensely red (10 R; 4/8) due to the presence of ferruginous pigments. The well rounded gravel material is composed quartz or quartzites, supported by argillaceous matrix. Planar or concave stratifications are frequent. Total thickness is 4.00 m.

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