COMPARATIVE STUDY OF ORGANIC MATTER WITHIN PHOSPHATIC GRAINS AND THEIR EXOGANGUE (RAS-DRAÂ DEPOSIT-TUNISIA). RELEVANCE TO PHOSPHATIC PELLETS GENESIS

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Abstract

The geochemical characterization of organic matter (OM) within phosphatic pellets (100-500 µm) and their surrounding matrices (<50 µm), collected from ypresian phosphorites (Ras-Draâ mine, Tunisia) indicates that : (1) Total Organic Carbon (TOC) content is more important in matrices than in pellets from the same layer; (2) A Marine planktonic origin of OM (Type II domain) contained in both fractions; (3) A diagenetic evolution of OM up to, and not beyond, the stage of humic compounds in both fractions; and (4) A higher abundance of extractable humic compounds in pellets (~70% TOC) and a lower extraction yield in matrices (~18% TOC). Such differences in geochemical properties between pellets and matrices are indicators of an allochtonous origin (fecal origin) of these grains within their embedded sediments.

Keywords: Organic Matter, Fecal Pellets, Geochemistry

Introduction

Several investigations of Tunisian phosphatic deposits have already showed that phosphatic components are essentially concentrated in phosphatic grains, called "pellets", varied in size (mainly 100 to 500 µm). These grains are surrounded by a sedimentary matrix, also named exogangue. The origin of phosphatic pellets has long been an intriguing problem, especially with regard to the source of the accumulated phosphorus. Two convergent hypothesis for the origin of pellets were proposed: either pellets were diagenetic, authigenic, bodies formed within and from the matrix and still containing chemical elements inherited from the matrix, or the pellets were allochtonous bodies (for example faecal pellets), formed outside the matrix. The present work aimed to carry compared studies of their geochemical properties and to draw some relevant conclusions on the genesis of the Ras-Draâ ore pellets.

Material and methods

The studied samples were collected from the Ras-Draâ deposit (southern Tunisia), witch is a natural continuity of the great Gafsa-Metlaoui phosphatic basin (Fig. 1). The phosphatic grains ("pellets", 100 to 500 µm in mean diameter) were separated from their surrounding sediments ("matrix", < 50 µm) by granulometric fractionation under water. The comparative study of both fractions was performed by: global chemical analyses (CNS elemental analysis), Rock-Eval (RE) pyrolysis and humic substances (HS) extraction and fractionation according to the IHSS (International Humic Substances Society) procedure.

Results and discussion

Elemental analysis: The Total Carbon (C_T) content in the phosphatic pellets is ~ 2.31% compared to ~ 3.52 % in the matrices. Total Nitrogen and Sulphur contents (N_T and S_T) are also significant and fairly homogeneous in the two respective fractions (N_T pellets ~ 0.03 %, N_T matrices ~ 0.07 %, S_T pellets ~ 0.11 %, S_T matrices ~ 0.16 %).

Rock-Eval pyrolysis: The TOC content, given by the RE pyrolysis, varies between 0.30 % and 1.62 % in phosphatic pellets and between 1.22 % and 4.05 % in their adjacent matrices. The geochemical characterization of OM contained in the two fractions by RE pyrolysis concludes, on one hand, to the planktonic origin of the OM (Type II domain), in both fractions, and, on the other hand, to a low degree of maturity of the pelletal and matricial OM (RE Tmax < 430 °C).

Humic substances extraction: The HS yields from the pelletal and matricial OM shows a high content of humic compounds isolated from pellets (humic carbon up to 75% of TOC) and a lower one in adjacent sediments (humic carbon less than 21% of TOC), along with the higher content of HU (low mature kerogen) in surrounding sediments and the lowest in the pellets. Such high amounts of humic compounds are similar to those isolated from Gafsa-Métlaoui phosphorites (Belayouni and Trichet 1983).

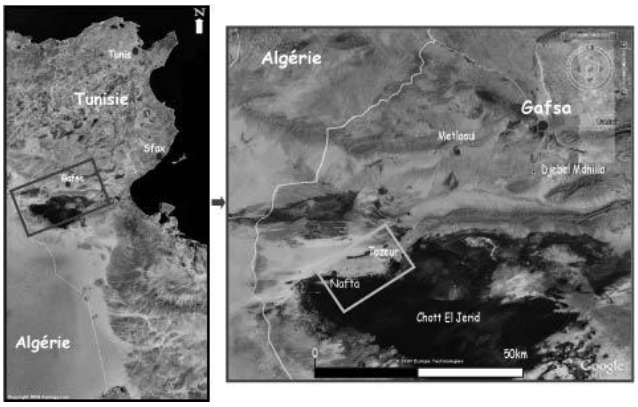

Fig. 1. Location map of the Ras-Draâ phosphate ore deposit in the Gafsa-Métlaoui basin, Tunisia (source: www.earth.google. fr)

Conclusion

Several organic geochemical data from the phosphatic grains and their surrounding matrix reveal great differences between the both fractions. Such differences excludes that the pellets formed authigenetically within and from their embedded sediments. The reasons of these different properties must been sought in the origin and the diagenetic history of the grains and of the matrix. Instead, as recently hypothetized (Ben Hassen 2007), these phosphatic pellets must have an allochtonous source, namely a biological origin since they are, very certainly, fish feces.

References

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