Supplementary material

The Phytoclast Group as a tracer of palaeoenvironmental changes in the early Toarcian

Bruno Rodrigues1\*, Ricardo L. Silva2,1, João Graciano Mendonça Filho3, Matías Reolid4, Driss Sadki5, M. J. Comas-Rengifo6, A. Goy6, Luís V. Duarte1

1 University of Coimbra, MARE-Marine and Environmental Sciences Centre, Department of Earth Sciences, Faculty of Sciences and Technology, 3030-194 Coimbra, Portugal.

2 Department of Geology & iCRAG, School of Natural Sciences, Trinity College Dublin, The University of Dublin, Ireland.

3 Department of Geology, Institute of Earth Sciences, Centre for Mathematical Sciences and Nature, Federal University of Rio de Janeiro, Brazil.

4 Departamento de Geología, Universidad de Jaén, Jaén, Spain.

5 Department of Geology, Faculty of Science, Moulay Ismaïl University of Meknes, Morocco.

6 Departamento de Geodinámica, Estratigrafía y Paleontología, Facultad Ciencias Geológicas, Universidad Complutense de Madrid, Espanha.

\*Corresponding author (e-mail: brunohteixeira@gmail.com)

**Methodology**

Thirty-five (35) marly samples previously collected in Aït Moussa and Issouka sections from the Middle Atlas (Morocco; see Rodrigues *et al*. 2020a) were analysed for δ13C in kerogen concentrate (δ13CKerogen). The δ13CKerogen analysis was conducted at the MAREFOZ (Coimbra University, Portugal), using the kerogen concentrate (carbonate-free fraction) prepared according to the standard, non-oxidative procedure described, for example, by Tyson (1995) and Mendonça Filho et al. (2012), among others.

Using a Flash EA 1112 Series elemental analyser coupled online via a Finningan Conflo III interface to a Thermo Delta V S mass spectrometer. The δ13C analysis was obtained using the Thermo Electron Corporation standards (i.e. Acetanilide, 71.09% C), and the internal precision is better than ±0.1‰. Gas species of different mass were separated in a magnetic field then simultaneously measured using a Faraday cup collector array to measure the isotopomers of CO2 at m/z 44, 45, and 46.

Table 1. δ13CKerogen data from Aït Moussa and Issouka sections (Middle Atlas)

|  |  |
| --- | --- |
| Sample ID | δ13CKerogen (‰) |
|
|
| Aït Moussa section |
| AM24 | -25,99 |
| AM23 | -25,16 |
| AM22 | -24,31 |
| AM21 | -25,25 |
| AM20 | -22,24 |
| AM19 | -21,11 |
| AM18 | -20,83 |
| AM17 | -21,24 |
| AM16 | -22,65 |
| AM15 | -21,10 |
| AM14 | -21,97 |
| AM13 | -22,91 |
| AM12 | -22,68 |
| AM11 | -22,01 |
| AM10 | -24,40 |
| AM9 | -23,58 |
| AM8 | -23,77 |
| AM7 | ---- |
| AM6 | -24,69 |
| AM5 | -24,74 |
| AM4 | -24,73 |
| AM3 | -23,10 |
| AM2 | -22,10 |
| AM1 | -20,82 |
| Issouka section |
| I 14 | -23,58 |
| I 13 | -22,97 |
| I 12 | -25,36 |
| I 11 | -27,64 |
| I 10 | -27,17 |
| I 9 | ---- |
| I 8 | -26,43 |
| I 7 | -27,72 |
| I 6 | ---- |
| I 5 | -20,53 |
| I 4 | -20,64 |
| I 3 | -22,08 |
| I 2 | -21,73 |
| I 1 | -21,71 |