

SESSIONE M4

Il colore degli eventi nel tempo

M4-1 Key Lecture Preat, Alain

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WHY IS 'RED MARBLE' RED : COULD FE-ISOTOPES SHED LIGHT ON THIS QUESTION THROUGH THE STUDY OF THE ITALIAN AMMONITICO ROSSO AND RECENT ORGANISMS?

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Key terms: Iron isotopes; Microbial mediation; Italian Jurassic Rosso Ammonitico; Recent sea urchins and bivalves; Red pigmentation of 'marble'

Eight iron (Fe) isotopic compositions of iron deposits in biofilms and granules found in two Recent burrowing marine invertebrates (the sea urchin *Echinocardium cordatum* and the bivalve *Montacuta ferruginosa*), were obtained by Multiple-Collector Inductively Coupled Plasma Mass

Spectrometry (MC-ICP-MS). $\Delta^{56}\text{Fe}$ values ranged between -1.78 and

-0.74 ‰. The lightest $\delta^{56}\text{Fe}$ is associated with the iron granules in the intestinal wall of *E. cordatum* and may be due to the abiotic oxidation of source Fe(II) with an isotopic composition reflecting that of light reduced Fe in sediment porewater. This lightest value could represent the best value for the pristine value. Fe in the biofilms was typically heavier by up

to +1.7‰, mean \sim +0.7‰. These results are compared with Fe isotopic composition of 17 Jurassic limestones from the Rosso Ammonitico Veronese (Italy) containing red and grey hemipelagic facies. The red facies show clear evidence of iron bacteria and fungi, which are interpreted as a possible equivalent of the iron microbial communities associated with the Recent organisms. Pronounced Fe isotope fractionation was observed in the Jurassic red hardground levels and in the more condensed red facies where bacteria and fungi lived and have

accumulated, with values typically lighter by -1‰ than the grey facies where micro-organisms were absent. This fractionation probably involved the passive accumulation of originally light porewater Fe in the EPS (exopolymeric substances) produced by filamentous bacteria, thereby favouring heavier Fe isotopes. Alternating stages of oxidation Fe(II)/Fe(III) occurred near the sediment/water interfaces as a consequence of microenvironmental changes in the marine porewaters and caused the red/grey facies interlayering. The comparison of the Fe isotopic compositions of the 'biominerals' in the Recent organisms and in the iron minerals of the red and grey Jurassic facies suggests an isotopic

biofractionation of at least \sim +0.7‰. Both studied organisms (the sea urchin and the bivalve) thrive in similar microenvironmental conditions as the micro-organisms of the condensed red facies. Their Fe isotope compositions are the same, as is the range of the probable biofractionation.

The microbial (iron-bacteria and fungi) hypothesis has the merit to be compatible with most observed pigmentation pattern. The pigmentation is due to the dispersion of submicronic (hydro)oxides in various studied Phanerozoic microaerophilic environments at dysoxic-anoxic interfaces or amorphous iron oxyhydroxide gel with phosphates formed by bacterial mediation during early diagenesis in the Recent organisms. The main limiting factor is the oxygen content which is always low in these very quiet microenvironments. Red pigmentation is therefore not linked to alteration or contamination of the studied Phanerozoic limestones. Iron-bacteria were present between the initial micritic components and thrived in the superficial part of the unconsolidated sediment. Omnipresent micronic regular filaments with Fe-rich sheaths and different types of ferruginous morphs are observed. There is no bathymetric influence on the process.

M4-2 Orale Vaccari, Ezio

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JUDGING BY COLOR IN THE EARLY HISTORY OF STRATIGRAPHY

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Key terms: history of geology; stratigraphy; color; 18th century

The aim of this paper is to evaluate some significant case studies, particularly during the 18th century, in order to understand how color was used as one of the 'external' features for identifying rock formations, also including fossils, regarded as formed in different times by different causes or events. The reference to color was often considered the main feature used for lithostratigraphical purposes within the so called 'classification' of mountains in the second half of the 18th century, as in the case of the research-work by Giovanni Arduino (1714-1795) in the 1760s and 1770s or Lazzaro Spallanzani's (1729-1799) geological studies in the 1780s and 1790s. Later geologists and mineralogists involved in the early history of stratigraphy, such as Abraham Gottlob Werner (1749-1817), referred to color when a rock formation or specimen appeared to be less defined by other main characters (for example chemical and morphological features).

M4-3 Orale Coccioni, Rodolfo

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CRETACEOUS-PALEOGENE ROCK COLOUR CHANGES IN THE UMBRIA-MARCHE BASIN: WHAT DO WE KNOW?

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Key terms: colour changes; Cretaceous-Paleogene succession; Umbria-Marche Basin; Italy

The Cretaceous-Paleogene succession of the Umbria-Marche Basin (Italy) exhibits several rock colour changes from white gray to green-gray and from pink and red (Oceanic Red Beds, ORBs) to gray-black and black, with the dark colours indicating the presence of high contents of organic matter there preserved (Oceanic Anoxic Events, OAEs).

These changes were on a scale of some hundred thousand years to several million years and their occurrence is not a completely random process, in particular with ORBs and OAEs mostly reoccurring alternately. Are these rock colour changes proxy signals for paleoenvironmental conditions? Are these changing scenarios a result of interacting changes in ocean dynamics, tectonics and climate? Are these rock colour changes isochronous and linked to any biotic event and crises in the marine ecosystems? Are these rock colour changes expressions of local or global (geo)events?

In recent years, a range of multidisciplinary studies has been carried out in the Cretaceous-Paleogene succession of the Umbria-Marche Basin so that a comprehensive data set with regard to document oxygen and carbon isotope excursions and paleoenvironmental settings using pelagic and benthic microfossils is now available within a stratigraphically and chronologically well constrained framework mainly based on calcareous nannofossils and planktonic foraminifera.

This succession represents, therefore, an exceptional laboratory to shed light on these issues.

M4-4 Orale Todesco, Rossana

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LIFE IN COLOUR. THE SILURIAN OF THE VALENTINTÖRL SECTION (CARNIC ALPS, AUSTRIA)

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Key terms: Silurian; Carnic Alps; Valentintörl Section; conodont biozonation; ferruginous laminated structures

The Paleozoic of the Carnic Alps is represented by almost complete sequences (Middle Ordovician - Late Permian in age) which crop out along the Italian-Austrian border with an east-west orientation. The significance of the Silurian of the Carnic Alps lies in the remarkable variety of facies exposed there and in the abundance of fossils that has enabled a precise biostratigraphic assignment of the sequences. In the area of Lake Wolayer (Carinthia, southern Austria) the Silurian crops out in four stratigraphic sections: Seekopf Base, Rauchkofel Boden, Base of Seewarte and Valentintörl. Whereas data available for the first three sections may provide a general overview of the sequences, information for the latter locality are limited to a preliminary dating carried out during the geological mapping of the area in the 1970s by Schönlaub (1970).

At the Valentintörl locality the successions occur on steep cliff faces and are not easily accessible. However, two sampling campaigns carried out in 2008 and 2009 along four different traverses have allowed a good general overview to be obtained. The section bears at the base a 17 m-thick white massive limestone rich in cystoids and bryozoans dated to the Late Ordovician Katian Stage (Amorphognathus ordovicianus conodont Zone). The extremely condensed Silurian succession is represented by 6 m of reddish cephalopod limestones intercalated with biodebris levels and grey to pink micritic limestones. Detailed conodont sampling has allowed six conodont biozones to be identified: Kockella crassa, Wurmiella hamata, Ancoradella ploekensis, Polygnathoides siluricus, Ozarkodina crispata and Auroradella detortus, thus assigning a biostratigraphic range spanning from the base of the Ludlow (Gorstian) to the Pridoli Series. At the top of the succession 4 m of light grey limestones document the earliest Lower Devonian (Icriodus woschmidti woschmidti conodont Zone). The basal part of the Silurian succession is assigned to the Kok Formation. Furthermore, the Cardiola Formation (Polygnathoides siluricus conodont Zone) has been documented for the first time at this locality, as a discontinuous, thinly developed centimetric layer of dark cephalopod limestone. The upper part of the Silurian succession is assigned to the Altilcola Formation (Oulodus elegans detortus Conodont Zone).

The biostratigraphy of the Valentintörl Section has been studied in great detail. The colour of the limestones exposed here is particularly remarkable, varying from grey to pink to red and even rusty-brown. This colour variation derives from the presence of micro-laminated ferruginous coatings around skeletal fragments (mostly trilobites, some cephalopods and echinoderms) as well as planar laminated structures along discontinuity surfaces such as at the Ordovician/Silurian boundary. These laminations are observed as pink to red and green signatures consisting of different iron phases (chamosite, goethite, magnetite, hematite and subordinate apatite) and have been interpreted as evidence of microbial activity (Ferretti et al., in press).

References

- Ferretti A., Cavalazzi B., Barbieri R., Westall F., Foucher F., Todesco R. (in press). From black-and-white to colour in the Silurian. In: Ferretti A., Histon K., McLaughlin P., Brett C.E. (eds), Time Specific Facies: the colour and texture of biotic events. Palaeogeography, Palaeoclimatology, Palaeoecology Special Issue (in press).
- Schönlaub H.P. 1970. Vorläufige Mitteilung über die Neuaufnahme der silurischen Karbonatfazies der Zentralen Karnischen Alpen (Österreich). Verhandlungen der Geologischen Bundesanstalt, 306-315.

M4-5 Orale Histon, Kathleen

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UNRAVELLING THE ENIGMA OF LOWER PALEOZOIC NAUUTOID CEPHALOPOD CONCENTRATIONS: INTERPRETING COLOURS AND EVENTS ACROSS SPACE AND TIME

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Key terms: Nautiloid cephalopods; bioevents; sediment colour; Lower Paleozoic; Paleobiogeography

Enigmatic concentrations of orthoconic nautiloid cephalopods form distinctive colourful strata which are often singled out for use as