

IAS Postgraduate Grant Scheme First Session 2009

Miocene seep-carbonates as indicators of different fluid sources in the northern Apennines - the case of Fosso Riconi and Croce della Moggiona cold-seep deposits (Italy)

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The IAS Postgraduate student grant was used to cover the costs of fluid inclusions analyses and nine carbon and oxygen isotope analyses in selected samples of Fosso Riconi and Croce della Moggiona seep-carbonates.

In the northern Apennines, numerous outcrops of Middle to Late Miocene seep-carbonates are excellently exposed in satellite and foredeep basins. They were recognized as products of the microbial oxidation of methane-rich fluids by their distinctive palaeoecological, compositional and isotopic features, and by lipid biomarkers (Aharon and Sen Gupta 1994; Ricci Lucchi and Vai 1994; Terzi et al. 1994; Cavagna et al. 1999; Conti and Fontana 2002; Peckmann et al. 2003).

In my PhD research I focused on two Miocene hydrocarbon-seeps “Croce della Moggiona” and “Fosso Riconi” enclosed in the Vicchio Marls (foredeep successions of the northern Apennine chain). Seep-carbonates are irregularly scattered, both laterally and vertically, and have irregular shapes and geometries, varying from stratiform to amygdaloid, lenses and pinnacles. Carbonate lithologies consist of weakly marly limestones, and marly limestones, dark to light grey in colour. The thickness varies from 50 dm to 7-8 m.

In order to assess if Fosso Riconi and Croce della Moggiona outcrops were ancient oil-seeps, the petrography of fluid inclusions was performed at the F.I. lab. of the University of Pavia. Fluid inclusions in diagenetic minerals provide one of the few tools that allow the reconstruction of the fluid history of a basin. As pore filling and authigenic minerals precipitate, microscopic inclusions of the pore fluid may be trapped and permanently sealed within the mineral phase. These “mineral bottles” may contain oil, natural gas or aqueous fluids, preserving the composition of paleo-fluids that migrated in the basin. The petrography of fluid inclusions was studied using an Olympus BX-60 microscope equipped with ultraviolet (UV) epi-illumination. Incident light fluorescence is used to distinguish many petroleum fluid inclusions from aqueous inclusions. The fluorescence system has a 100 watt mercury bulb focused and it uses a narrow-band ultraviolet (365±5 nm) excitation filter.

The majority of fluid inclusions in Fosso Riconi and Croce della Moggiona carbonate phases have a size less than 1 micron; these fluid inclusions haven't the workable size range, which is typically from several microns to tens of microns. Fosso Riconi fluid inclusions are vapour and liquid aqueous while few and little Croce della Moggiona inclusions show a bright blue and yellow-green fluorescence. These inclusions are found along calcite crystal faces and, rarely, along microfractures that penetrate the calcite. The bright blue and yellow-green fluorescence is probably due to bitumen and/or oil inclusions. The presence of petroleum inclusions in Croce della Moggiona carbonate samples provides a record of paleo-petroleum migration in the basin.

With IAS grant financial support it was also possible to perform carbon and oxygen isotopic measurements in order to better characterize the different carbon isotopic sources mixed in the formation of authigenic carbonates. For the majority of the Fosso Riconi and Croce della Moggiona examined seep-carbonates a variable amount of mixing of carbonate derived from oxidized methane, and from seawater (DIC) and sedimentary organic matter can be hypothesized. The stable isotopic analyses were performed at “ISO4” Stable Isotope Laboratory of the Torino University.

A more detailed overview of the costs covered by the IAS grant is given below:

Laboratory analyses		
Carbon-oxygen stable isotope analyses	688.80	“ISO4” Stable Isotope Laboratory of the Torino University
Microstructural analyses of Fluid Inclusion	360.00	F.I. lab. of the University of Pavia
TOTAL	1048.80	

References

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