

# Euromlanet TNA Report

## PROJECT LEADER

<b>Name:</b> Mark Sephton
<b>Address:</b> Department of Earth Science and Engineering South Kensington Campus, Imperial College London, SW7 2AZ
<b>E-mail:</b> m.a.sephton@imperial.ac.uk

## COLLABORATORS

<b>Name:</b>	<b>Affiliation:</b>
Gian Gabriele Ori	Universita d'Annunzio Viale
<b>Date of TNA visit:</b>	9 <sup>th</sup> – 26 <sup>th</sup> September 2011
<b>No. of days:</b>	14
<b>Host laboratory:</b>	Ibn Battuta Centre, International Research School of Planetary Sciences, Universita d'Annunzio
<b>Reimbursed</b>	Yes

## Project Title – Palaeoenvironmental reconstruction of a Devonian hydrothermal vent

### **Scientific Report Summary.**

*(plain text, no figures, maximum 250 words, to be included in database)*

The perfectly preserved mound structures in the Hamar Laghdad region have been subject to much controversy relating to their origin as hydrothermal vents or hydrocarbon seeps. Here we present new evidence, using biogeochemical techniques and field observations in conjunction with the available literature, to synthesise the current work into a coherent geological interpretation; the conclusions of which result in the replacement of the previous hypotheses and propose a combined theory of mound generation. Silurian black shale deposits heated to low thermal maturity by a small igneous intrusion result in localised production of cold organic-rich fluids, which are transmitted to the surface via tectonically induced normal, and strike slip syn-sedimentary faults during Devonian extension.

## Full Scientific Report on the outcome of your TNA visit

Approx. 1 page

Hydrothermal seeps and hydrocarbon vents are important ecosystems in the modern environment, and in the geological record. It has been postulated that such places could be where life originated, places where life could have been preserved during global mass extinctions, and potential sites to look for life on extraterrestrial bodies.

Hamar Laghdad has been intensively studied since the 1930s. There have been several hypotheses for the mechanism which formed the mound structures including hydraulic piling and fluid migration. The debate still rages on the origin and nature of these fluids. Hydrothermal vent fluids, and cold thermogenic or biogenic methane/hydrocarbon seep fluids have both been suggested. The analyses conducted in the literature have been many and varied, however the flaw in the majority of studies is their reliance on one method as the basis for the whole conclusion.

For this study detailed field mapping (Figure 1) and organic geochemical analyses were combined to assess the formation of the Hamar Laghdad mounds and their relationship to regional geology.

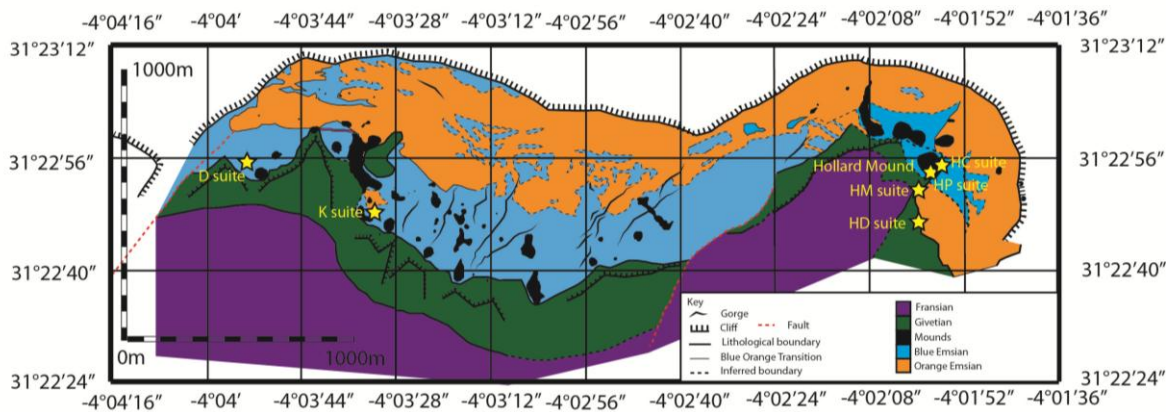


Figure 1. A detailed geological map of the study area.

The mound structures observed in the Hamar Laghdad region are most likely formed by cold hydrocarbon-rich fluids migrating from the Silurian black shale, with a low degree of thermal maturation provided by an enhanced geothermal gradient generated by Devonian extension. Remnants of these fluids were detected by gas chromatography-mass spectrometry. A small intrusive laccolith may provide the remaining missing heat source. These fluids migrate up syn-sedimentary faults, which are aligned in agreement with a Devonian extension NNE-SSW, and continue into the upper Devonian sediments, hence the calcite veins cross-cut the boundary with the same geochemical signal as the mound facies. The mounds predominantly form at the intersection of the main syn-sedimentary faults. There is some evidence for hydrothermal activity however it is not conclusive and other feasible mechanisms could develop a similar signal. The fluids induced rapid lithification of the sediments, so preserving the high slope angles and the reef building organisms were deemed too few to cement the strata so rapidly. The cessation of fluid seepage is concurrent with the lithological facies change.

Please include:

- Publications arising/planned (include conference abstracts etc)

Daly L. 2012. Palaeoenvironmental reconstruction of a Devonian hydrothermal vent. MSci Thesis, Imperial College London.

Daly L., Montgomery W.B., Allison P.A., Ori G.G., and Sephton M.A., Palaeoenvironmental reconstruction of a Devonian hydrothermal vent. Geology, in preparation.

- Host approval The host is required to approve the report agreeing it is an accurate account of the research performed.