

sions both for FileMaker and MySQL have been tested on the web.

Renewed interest has led to re-identification of many samples and their stratigraphic position. Large data sets have been selected for biostratigraphic studies including Carboniferous and Permian fusulinids, many previously unknown from Novaya Zemlya, inorganic and organic geochemistry. Several reports have been prepared. One ongoing sub-project is to prepare an atlas of thin sections of specimens from selected areas and stratigraphic levels.

Currently the data is available only to sponsors of the project, but it is intended to make results known to the public in the near future.

## Hydrocarbon seeps from the uppermost Jurassic, Western Spitsbergen, Svalbard

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Carbonate mounds, interpreted as being the result of hydrocarbon (or cold) seepage, outcrop in the Upper Jurassic dark silt- to paper-shale succession of the Agardhfjellet Formation, Slottsmøya Member, Knorringsfjellet area, Spitsbergen, Svalbard. Four mounds were mapped during field work in 2008, the largest being 3-4 m high and 7 m wide. Field work in the Knorringsfjellet and Janusfjellet area in 2009 revealed 10 more mounds. Analyzed samples from these mounds include zoned (botryoidal) carbonate of varying yellow to brown colour, fissure-infilling sparite, and various fossil shell material.

The macrofauna consists mainly of small to medium sized bivalves (<10 mm, up to 70 mm wide), rare brachiopods as well as worm tubes. Bivalves include at least eight species, including the largest known *Nucinella*, *Oxytoma* (or *Meleagrinnella*), *Pseudolimea*, a solemyid, a lucinid and possible arcticids and 'thyasirids'. Large accumulations of the bivalve genus *Buchia* are present in all mounds as well as in the dark surrounding shale. Gastropods, usually only preserved as internal moulds, are not common, but a species of *Amberleya* has tentatively been identified. Brachiopods are represented by probably three terebratulid species, two rhynchonellid species, as well as more common lingulids. Vestimentiferan as well as serpulid

worm tubes are also present. A rich microfauna consisting of uncompact agglutinated foraminiferan specimens of *Recurviodes scherkalyensis*, *Evolutinella schleiferi* and *Ammobaculites cf. gerkei* has been retrieved from dissolved carbonate samples. Calcareous foraminiferans and radiolarians have also been observed in several thin sections. Embedded ammonites and large (up to 40 x 1500 mm) wood pieces are considered to be from surface waters and not related to hydrocarbon seepage.

Stable isotope analyses show highly negative  $\delta^{13}\text{C}$  values ( $\sim -43\text{‰}$  VPDB) in the zoned carbonate whereas the sparite, ammonite and bivalve samples have  $\delta^{13}\text{C} \sim -22\text{‰}$ . The  $^{13}\text{C}$  depletions indicate a methanogenic carbonate origin, in the range typical of thermogenic, rather than biogenic ( $< -60\text{‰}$  PDB) methane. The ammonite and bivalve shells would originally have had normal-marine isotopic compositions. Their observed negative  $\delta^{13}\text{C}$  values can be explained by recrystallization with introduction of light carbon from the authigenic carbonate. Large depletion of  $^{13}\text{O}$  in the sparite, ammonite and bivalve material ( $\delta^{13}\text{O} \sim -18\text{‰}$ ) indicates precipitation and recrystallization involving hydrothermal fluids, either synsedimentary, or in connection with sill emplacements in the Cretaceous. The isotope data from the carbonates will be compared with data from surrounding shale samples from where organic carbon isotope logs have been made.

## The palaeoclimatic significance of archaeological finds exposed at retreating ice patches in Jotunheimen, Norway

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After 2000, retreating ice patches in Jotunheimen have exposed unique prehistoric remains related to reindeer hunting. The reindeer have in past, as at present, stayed on snow patches during warm days in the summer in order to avoid insects. Extensive reindeer hunting has taken place on and at such ice patches. Numerous objects related to this hunting activity, such as arrows, scaring sticks, and stone shelters ('bogestille'), have been detected at the retreating ice patches. The oldest and most spectacular find so far is a leather shoe (size 38) dated to ca. 3400 cal. yr BP. In 2007-2009, detailed multidisciplinary investigations were carried out at Gjuvfonni (near Galdhøpiggen) at an elevation of ca. 1850 m. Scaring sticks there date to AD 380-580 and AD 760-970. The age of the archaeological finds will be discussed in the context of late Holocene climate variations and glacier fluctuations.