Sedimentological and geochemical environment of the Fugløy Reef off northern Norway

Björn Lindberg, Jürgen Mienert

Department of Geology, University of Tromsø, Norway, Dramsveien 201, N-9037 Tromsø, Norway
(Bjorn.Lindberg@ig.uit.no)

Abstract. A number of reefs are found along the coast of northern Norway, and a cluster of particularly high reefs off Troms County at 70°N are known collectively as the Fugløy Reef. The reefs, up to 40 m high and more than 200 m wide, consist mainly of the reef-building *Lophelia pertusa*. Most of the reefs identified in the study area are located on moraine ridges in water depths of 140-190 m, and in water masses dominated by the relatively warm and saline Norwegian Current. Several of the reefs are located on the flanks of channels incising the moraine highs, where currents are tidally dominated and periodically reach velocities of 30 cm/s. Gravity cores were acquired from the reefs and their surroundings, and thorough analyses of the sampled sediments provide valuable information about three (paleo-) sedimentary environments surrounding the reefs. The immediate vicinity of the reefs consists of coarse and unsorted deposits that are interpreted to be moraine material deposited by the retreating inland ice. Elevated current velocities have prevented fine sediments from settling since the ice retreated. The second province is a pockmarked basin at water depths down to ~300 m. Gravity cores from the basin reveal silty sand deposits of more than 4 m thickness representing post-glacial sedimentation in the area. Gas analyses reveal that the hydrocarbons found in the sediments clearly are of biogenic origin, although it is somewhat enigmatic whether biogenic gas is the sole driving force behind the pockmarks in the area. No direct link between the reefs and the pockmarks is found. The third sedimentary province is characterised by resedimentation of coral debris, clearly illustrated by sorted deposits and U/Th-datings from the allochthonous deposits. Remobilisation of coral debris is modest in areal extent, but an important mechanism linked to the occurrence of the coral reefs.

Keywords. Cold-water corals, *Lophelia*, geochemistry, sedimentology, dating

Introduction

Cold-water corals along the coast of Norway have been known for several decades, but thorough scientific studies were first conducted in the 1920’s and
1930’s. The introduction of manned and unmanned submersibles in the 1980’s led to an increased scientific and societal interest, and several hundred areas of reef growth have now been identified on the Norwegian shelf and in fjords (Fosså et al. 2000). Among the largest and best-known reefs is the Sula Reef Complex off mid-Norway which encompasses several hundred individual reefs en echelon over a distance of 14 km (e.g., Hovland et al. 1994; Mortensen et al. 1995; Freiwald et al. 2002). The Røst Reef is reported to be even larger, stretching for 35 km along the shelf edge, and is the subject of ongoing studies (Fosså et al. 2005). The role of hydrocarbons through (micro-) seepage in relation to reef growth is a subject of recurring discussion, and a theory has been formulated linking the reefs to increased nourishment supply due to the chemical front created by introduction of ‘foreign’ elements in the water column (‘the hydraulic theory’; Hovland 1990; Hovland and Mortensen 1999). This theory is disputed by other authors (e.g., Frederiksen et al. 1992; Freiwald et al. 1997), who claim oceanographic factors determine the distribution of the reefs.

New data presented in this paper illuminate several processes linked to the Fugløy Reef and the adjacent pockmarked basin discussed in Lindberg et al. (submitted). The sedimentary environment surrounding the reefs is described based on analyses of gravity cores. Geochemical analyses of the gas in the sediments as well as dating of coral fragments provide additional information about the geological development of the area.

The paper is based on further analyses of existing geophysical data presented in Lindberg et al. (submitted), as well as new data from gravity cores, additional very-high-resolution acoustic data and oceanographic measurements.

**Physiographic setting**

The Fugløy Reef is located at 70°N at the mouth of prominent fjords up to 300 m deep incising the Norwegian mainland (Fig. 1). The basement consists of metamorphosed bedrock of Cambro-Silurian age, with sedimentary Mesozoic bedrock found less than 20 km to the north (Sigmond 1992). The area has repeatedly been glaciated during the last 600 ka (Henrich and Baumann 1994), thereby scouring most of the sediments off the shelf and into the deep-sea, leaving mostly moraine ridges and sub- and pro-glacial tills after the ice-sheet retreated. Post-glacial sediments consist of glaciomarine deposits with dropstones, and Holocene marine sedimentation, constituting >20 m in thickness in local basins (Rokoengen et al. 1979; Vorren and Kristoffersen 1986; Lindberg et al. submitted).

The large-scale oceanography is dominated by the northwards flowing warm North Atlantic Current (typically T: 6-9°C and S: >35 ‰), overlain by the Norwegian Coastal Current, usually constituting a colder and less saline water mass (Blindheim 1990; Loeng 1991; Poulain et al. 1996). Detailed oceanographic measurements have proven the influx of Atlantic Water at the reef sites with a strong tidal signal, periodically yielding current velocities of more than 30 cm/s (Lindberg et al. submitted). Measurements performed over several years at a nearby hydrographic