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The dating and morphometry of the Storegga Slide

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Abstract

The Storegga Slide has affected an area of approximately 95 000 km^2, and a sediment volume in the range of approximately 2400–3200 km^3 has been displaced. Around 250 km^3 of the volume has been deposited as turbidite sediments in the Norway Basin. This volume places the Storegga Slide event as one of the world's largest exposed submarine slides. Based on a comprehensive database, detailed morphological investigations and a dating programme have been performed to reveal the slide process and the timing of the slide. To date the slide event, detailed analyses of 89 cores within the Storegga Slide region have been undertaken. The investigations conclude: (a) The main Storegga Slide event represents one retrogressive event dated to be 7250±250 ^{14}C yrs BP or approximately 8100±250 cal. yrs BP. This age also corresponds with the age of a tsunami found along the western coast of Norway. (b) A few minor slide/slump events have been identified along the northern Storegga Slide escarpment, dated to be c. 5000 ^{14}C yrs BP and 2500–3000 ^{14}C yrs BP or approximately 5700 and 2200–2800 cal. yrs BP. The total volume of these events is interpreted to be less than 1 km^3 or c. 0.1% of the total volume calculated for the main Storegga Slide event. (c) The statistical analyses carried out on the lobes morphometrical parameters show a fairly good correlation (R^2=0.8–0.9) between the smallest and the medium/large size debris lobes within the Ormen Lange Field area. This means that the rheological properties for this area can be described as fairly uniform for the slide masses and scaling of the morphometrical parameters should be possible with a great confidence.

Keywords: Submarine slide; AMS dating; Slide morphometry

1. Introduction

The Storegga Slide area (Storegga Slide depression—North Sea Fan) has been exposed for a number of large-scale submarine landslides during the last c. 1 Ma (Evans et al., 2005). The first large slide is also associated in time with the first glacial advance to the shelf break off mid-Norway (e.g. STRATAGEM Partners, 2002; Bryn et al., 2003; Evans et al., 2005; Sejrup et al., 2005). The stratigraphical evidence have revealed that frequency of these large slide events occurred at more semi-regular intervals after c. 0.5 Ma also associated with regular advance of the glacier to the shelf break (e.g. Bryn et al., 2003; Nygård et al., 2005; STRATAGEM Partners, 2002; Evans et al., 2005; Sejrup et al., 2005). The size and frequency of these submarine slope failures clearly indicate that this process has been a major mechanism in transporting sediments from the shelves and upper slope areas down-slopes to the deep-sea basin.

The present day exposed Storegga Slide is the last large-scale slide that has failed in this area, affecting an area of approx. 95 000 km^2 and displacing a volume of 2400–3200 km^3 (Haflidason et al., 2005) (Fig. 1, Table 1). The Storegga Slide, also considered to be the largest exposed submarine slide in the world, is an order of magnitude larger than other exposed slides found in these high latitude margin areas (e.g. Vorren et al., 2003; Haflidason et al., 2005). The large-scale size of the slide has also raised the question if the slide has been created during only one mass failure event or during a series of separate events. Previous dating results carried out during the 1980s on the Storegga Slide concluded that the slide scar

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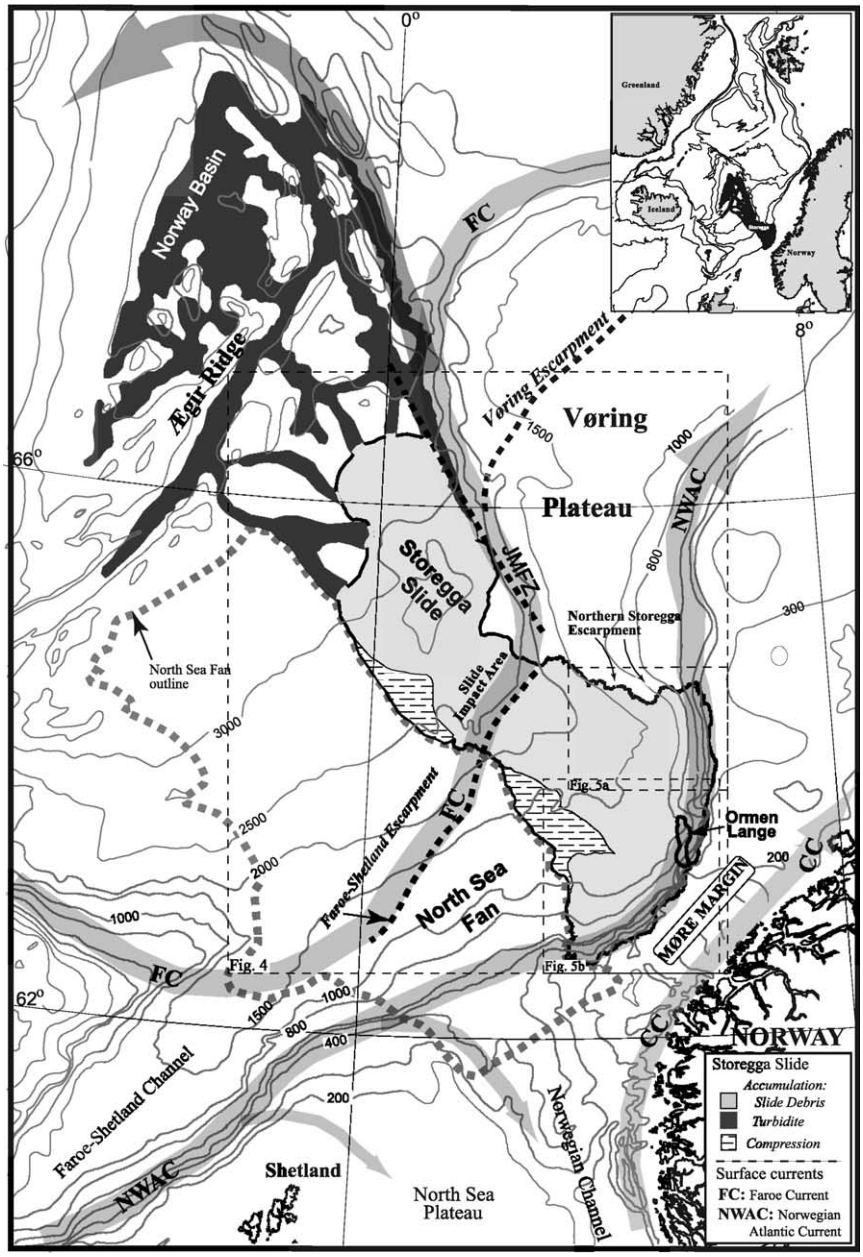

Fig. 1. Bathymetric map of the southern Norwegian Sea and of the southern Norwegian margin area showing the detailed outline of the Storegga Slide. The shaded arrows represent the highest current rate of these branches. The inserted map shows a bathymetric map of the Norwegian-Greenland Sea with the outline (in black) of the Storegga Slide.

was a result of three distinctive slide events (Bugge, 1983; Bugge et al., 1987; 1988; Jansen et al., 1987).

Later observations of distorted sequences in shallow marine or lacustrine basins in western Norway, Scotland and on the Faroe Islands led to the conclusion that a tsunami, interpreted to be related to the Storegga Slide event, inundated these coasts most likely around 7250–7350 ^{14}C yrs BP (e.g. Bondevik et al., 1997; 2005; Grauert et al., 2001). Furthermore, evidence of tsunami generated slide debris and turbidites deposits created during the Storegga tsunami event close to 7200 ^{14}C yrs BP has been seismically identified, cored and dated in a large number of fjord basins along the mid- and western Norwegian coast (Grøsfjeld et al., 1999; Gudmundsdottir, 2002; Bøe et al., 2004). These deposits therefore form a regional chronostratigraphical marker on the margin, in fjords and in coastal deposits of Norway.

During the last decade or so a large amount of high-resolution acoustic data (seismic, side scan sonar, swath bathymetry) and sediment cores (shallow borings, piston- and gravity cores) have been collected within the Storegga Slide area in connection with hydrocarbon exploration and for slope stability risk assessment. Some of the key parameters for the risk assessment analyses have been