The Lower Oligocene-Lower Pliocene Molo Formation on the inner Norwegian Sea continental shelf

(Extent and thickness, age from fossil and Sr isotope correlations, lithology, paleobathymetry and regional correlation)

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The Molo Formation is a sand-dominated unit on the middle inner part of the shelf extending from the coast off Møre (57°10'N) to Lofoten (67°10'N). It has a unique seismic signature, and represents a prograding system comprising largely chalk forms (Fig. 5, Profiles 1-4). Eidvin et al. (1996a) investigated sideward cores of the Molo Formation in well 6610/3-1 (in its northern part) and gave an Early Oligocene age for the unit based on benthic foraminiferal and dinoflagellate cyst correlations and strontium isotope analyses. At a later date T. Eidvin and M. Sænæs investigated sideward cores of the same formation in well 6510/2-1 (in its middle part of the formation). Based on the same kind of analyses they suggested an Early Miocene age for the formation in that well. Eidvin et al. (2007) investigated ditch-cutting samples of the Molo Formation in well 6407/9-5, 6407/9-2 and 6407/9-1 (in its southern part) and based on the same kind of analyses they suggested a Late Miocene to Early Pliocene age for the unit in those wells.

Eidvin et al. (2007) interpreted the Oligocene fossils in well 6610/3-1 (Fig. 6) and the Early Miocene fossils in well 6510/2-1 (Fig. 8) to be reworked and suggested a post mid-Miocene age for the whole of the Molo Formation. They interpreted the Molo Formation to be the proximal equivalent to the deeper marine Kai Formation. However, interpretation of new seismic data for the current presentation indicates the northern proximal part of the Molo Formation is as old as Early Oligocene and that the formation contains younger sediments towards west and south (Fig. 5, Profile 1-4). We now believe that the recorded index fossils in well 6610/3-1 (Fig. 6) and 6510/2-1 (Fig. 8) are not reworked, and that the Molo Formation is the proximal equivalent to both the Brygge and Kai formations (Profiles 1-4, Fig. 10). Eidvin et al. (2007) suggested 6610/3-1 from 555 to approximately 346 m; Fig. 6, the top is not sampled and logged as the well type section and 6407/9-5 from 787 to 670 m as well reference section (Fig. 8). For the current presentation we suggest well 6610/3-1 from 480 to 441 m (Fig. 5, the top is not sampled and logged) as well reference section.

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**Figure 1**: Map of the study area showing the location of the wells and the Molo Formation.

**Figure 2**: Geochronology of all studied wells including the 5 wells with the Molo Formation. The boundaries between the Oligocene, Lower Miocene and Upper Miocene-Lower Pliocene parts of the Molo Formation are tentative and after F. Riis (work in progress).

**Figure 3**: Regional geoseismic line across the Utgaard High and along the Nordland Ridge through well 6607/5-1 (see also Map 1 for location, modified after Eidvin et al. 2000).

**Figure 4**: Geochronology of studied wells, boreholes and outcrops. Vertical axis is in Ma.

**Figure 5**: Lithostratigraphic diagram showing the stratigraphic framework of the Molo Formation. The Lower Oligocene-Lower Pliocene Molo Formation on the inner Norwegian Sea continental shelf.

**Figure 6**: Event summary and geographical distribution of the Molo Formation on the Norwegian shelf. The Molo Formation is a sand-dominated unit on the middle inner part of the shelf extending from the coast off Møre (57°10'N) to Lofoten (67°10'N). It has a unique seismic signature, and represents a prograding system comprising largely chalk forms (Fig. 5, Profiles 1-4). Eidvin et al. (1996a) investigated sideward cores of the Molo Formation in well 6610/3-1 (in its northern part) and gave an Early Oligocene age for the unit based on benthic foraminiferal and dinoflagellate cyst correlations and strontium isotope analyses. At a later date T. Eidvin and M. Sænæs investigated sideward cores of the same formation in well 6510/2-1 (in its middle part of the formation). Based on the same kind of analyses they suggested an Early Miocene age for the formation in that well. Eidvin et al. (2007) investigated ditch-cutting samples of the Molo Formation in well 6407/9-5, 6407/9-2 and 6407/9-1 (in its southern part) and based on the same kind of analyses they suggested a Late Miocene to Early Pliocene age for the unit in those wells.

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**Figure 7**: Map showing the location of the study area and the positions of the wells and the Molo Formation.

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**Figure 8**: Map showing the location of the study area and the positions of the wells and the Molo Formation.