Correlation of transgressive–regressive depositional sequences in the Middle Jurassic Brent/Vestland Group megacycle, Viking Graben, Norwegian North Sea

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The Tarbert and Hugin Formations (mainly Bajocian/Bathonian to Callovian) of the northern North Sea were formed in the overall transgressive phase of the Brent/Vestland Group megasequence. Detailed correlation of c. 25 wells in the Norwegian sector reveals a composite pattern of transgressive–regressive (T–R) depositional sequences in these formations.

The depositional sequences are identified on the basis of wireline logs and sedimentological core descriptions. Sequence boundaries are defined based on allostratigraphic (NACSN, 1983) principles. A framework of palynological events is established and used as support for the sequence correlation between the wells. This framework constitutes a compilation of data from the wells in the study area and other well documented sequences in the north and the south of the area.

The T–R depositional sequences are composed of a thin transgressive unit (sometimes lacking), and a regressive (progradational and aggradational) unit forming the main portion of the sequence. They typically span 1–2 Ma and so compare with the third-order cycles of Vail et al. (1977).

The regressive units reflect progradation (generally northward) and aggradation of tidally influenced shoreline complexes, backed by tidal inshore systems and coal-forming coastal plains (Ness/Sleipner Formation). In an offshore direction, marine silts and muds were deposited (Heather Formation).

The regressive parts exhibit different developments depending upon their position in the basin. Distally, relatively clear coarsening-upwards trends can be observed, whereas more complex patterns of aggradation and progradation occur in proximal areas.

In the Bajocian to Callovian interval, six T–R depositional sequences are identified, separated by hiatuses of various magnitudes. The sequences can be mapped out and successively over-step each other in a southward direction, reflecting successively higher eustatic high-stands or increasing subsidence rates.

The Tarbert and Hugin Formations thus reflect an overall transgressive phase from the Bajocian through the Callovian, interrupted by repeated regressive episodes. The influence of eustacy and tectonism/https://en.wikipedia.org/wiki/Isostasy on sequence genesis cannot be definitely resolved.

INTRODUCTION

The Brent Group and Vestland Group are distributed in the northern and southern parts respectively of the Viking Graben of the northern North Sea (Fig. 1). Their lithostratigraphic subdivision and interrelationships are defined by Vollset and Dore (1984) (Fig. 2). In part, these two groups are time equivalent and, together with the fine-grained marine deposits of the Heather Formation (Viking Group), they form a depositional megacycle of deltaic and coastal advance and retreat in the pre-rift Viking Graben basin and adjoining areas (Graue et al., 1987). This megacycle spans the Middle Jurassic, starting in the Aalenian and stretching into the Oxfordian of the Upper Jurassic. Sandstones of the Brent and Vestland groups form prolific reservoirs in a large number of northern North Sea oil- and gasfields (Statfjord, Gullfaks, Brent, Sleipner and other fields).

Initiation of Brent and Vestland group deposition was associated with uplift in the south and on the flanks of the Viking Graben, and a delta which progradated northward. Onset of the main advance of the delta was associated with coarse-clastic deposition, forming the Broom and Oseberg formations. According to the synthesis of Graue...
In the overall transgressive, retreating phase of the megacycle, marine sandstones of the Tarbert and Hugin formations were laid down as a series of offset, backstepping regressive sequences, backed by coastal plain deposits of the Ness and Sleipner formations, and with distal, fine-grained equivalents in the Heather Formation. Tidal influence was increased in this overall transgressive phase as compared with the regressive, delta progradation phase (Harris and Fowler, 1987; Rønning and Steel, 1987). The retreating phase was associated with increasing subsidence in the southern part of the area, and some pre-rift fault tectonism (Badley et al., 1987; Larsen, 1987).

The present chapter aims to discriminate the transgressive-regressive (T-R) depositional sequences in the overall transgressive phase of the Brent–Vestland Group megacycle. They are correlated and mapped, in order to provide a tool for prediction of sandstone distribution and quality. Also, we wish to elucidate stratigraphic relationships between the Brent Group and the Vestland Group in the mid-Viking Graben areas, around 60°N, where little information has been available. To achieve both of these aims, it is necessary to combine biostratigraphic techniques with sedimentological concepts of depositional sequence development.

Wireline logs and biostratigraphic data from a number of selected wells on the Norwegian shelf were used as the main basis for the study. The studied transect follows a north–south trend along the Viking Graben from the Statfjord Field in the north to the Sleipner Field in the south, crossing the flanks of the Utsira High (A-A’ in Fig. 1). Cores were studied to support sedimentary facies interpretations, and new biostratigraphic studies were performed on some wells due to the poor quality of existing data.

**SEQUENCE STRATIGRAPHIC PRINCIPLES**

In recent years it has become clear that sequence correlation is a powerful tool for predicting reservoir sandstone and source rock distributions. The correlation of depositional sequences, as done in this work, is based on the