Stratigraphic architecture of an ancient deep-marine channel-lobe transition zone (CLTZ), Kaza-Isaac transition, Windermere turbidite system, Cariboo Mountains, B.C.

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Abstract

At the Castle Creek area, deep-marine rocks of the Windermere Supergroup show a km-scale upward change from intercalated, sheet-like, Dm-thick sandstone and mudstones (Upper Kaza Group) to Dm-thick channelized sandstones bounded by mudstone (Isaac Formation), which, respectively, are interpreted to represent proximal basin floor and slope deposits. These two end-member architectures are commonly separated by an intervening interval termed the channel-lobe transition zone, or CLTZ. Although well imaged in modern sea-floor seismic images, little is known about the lithofacies distribution, stratigraphic architecture or evolution of strata that make up the CLTZ. The Kaza-Isaac transition, therefore, provides an ideal opportunity to study the facies and architectural changes through a well-constrained channel to lobe transition.

The CLTZ in this study area is ~200 m-thick and can be traced laterally for >1.5 km. Detailed outcrop analysis demonstrates that it contains a diverse and complex assemblage of stratal elements, including debrites, feeder channels, crevasse splays, scours, proximal distributary channels, distributary channels, bar deposits, terminal splays, and fine-grained sheets. Besides, the CLTZ is directly overlain by the first slope channel-levee complex of the Isaac Formation. In comparison to earlier works on underlying basin- floor strata in the area (e.g. Meyer and Ross, 2007; Rocheleau, 2012; Terlaky, 2014), the elements unique to the transition zone are scours and proximal distributary channels, and these are well developed here.

Scours form isolated erosional features most commonly encased in laterally-continuous, thick mudstone-dominated (i.e. thin-bedded, fine-grained turbidites) sheets. Scours are generally shallow (up to 4 m-deep, although one example is estimated to be Dm-deep), extend

laterally from tens to several hundred meters, and are filled with thick- to medium-bedded, amalgamated coarse-grained and very coarse-grained sandstone that show little vertical or lateral change in lithology. Nonetheless, some scours are filled with granule conglomerate, parallel-bedded coarse-grained sandstone, clast-rich debrite, or fine-grained upper division thin-bedded turbidites. Scours are interpreted to have formed immediately downflow of the terminus of slope channels as they debouched onto the proximal part of the basin floor. Erosional features similar in dimension to those described here have been reported from the CLTZ in a number of modern deep-marine turbidite systems (Wynn et al., 2002; Macdonald et al., 2011).

Proximal distributary channels, which comprise multiple, vertically-stacked, nested channels, form broad, 'sheet-like' units that are up to 10 m thick and extend over hundreds of meters laterally. Individual channels are shallowly scoured (<1-3 m deep), up to 300-400 m wide, and typically filled with amalgamated very coarse- and coarse-grained sandstone that tend on one side, and over tens to hundred of meters laterally, gradually fine, thin and become less amalgamated. The lateral and vertical nesting of shallow channelforms build up units that are interpreted to be equivalent to channelized sheet elements commonly reported from seismic images (e.g. Sullivan et al., 2000, 2004). Proximal distributary channels, or similarly channelized sheets, are interpreted to occur in the proximal, weakly confined part of a distributive channel system that further downflow progressively splits and feeds into a network of terminal distributary channels, that ultimately feed terminal splays.

Scours, although ubiquitous in the transitional zone, are most common in its lower part. Proximal distributary channels, on the other hand, are not only common in the lower but also middle part of the CLTZ. Since the distribution of these elements can have important consequences on hydrocarbon reservoir distribution and connectivity, it is essential that they be incorporated into any submarine fan model that includes the CLTZ.

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