Paper VIII
The Upper Carboniferous deep-water rocks of the Shannon Group were deposited in the extensional Shannon Basin of County Clare in western Ireland, and are exposed in sea cliffs along the Shannon Estuary (Figure 1). Carboniferous limestone floors the basin, and the basin fill succession begins with the deep-water Clare Shales. These shales are overlain by various turbidite facies of the Ross Formation (460 m [1509 ft] thick). The type of turbidite system, scale of turbidite sandstone bodies, and the overall character of the depositional environment are much like those reported from other passive margin basins around the world.

Table: Ross Formation, Shannon Basin

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Location</td>
<td>County Clare, Western Ireland</td>
</tr>
<tr>
<td>Age</td>
<td>Late Carboniferous (Namurian)</td>
</tr>
<tr>
<td>Formations</td>
<td>Ross Formation</td>
</tr>
<tr>
<td>Basin Size</td>
<td>ENE-WSW elongation, 20 km² (7.8 mi²)</td>
</tr>
<tr>
<td>Region/province/state</td>
<td>Shannon Estuary</td>
</tr>
<tr>
<td>Other</td>
<td>Superbly exposed in sea-cliffs along the Shannon Estuary and the County Clare coast. Continental offshore deposits are present in County Clare, and may also be present in the offshore Outer Hebrides and Orkney Islands.</td>
</tr>
<tr>
<td>Depositional Setting(s) Interpretation</td>
<td>Progradational sand-rich fan system with frontal splays in the lower part, to channels with up to 500 m (1640 ft) wide. Overbank lobes are composed of the thin-bedded architectural element and show change from tabular sheets to channels and thickening upwards packages interbedded with thin-bedded mudstones and siltstones</td>
</tr>
<tr>
<td>General Outcrop Description and Stacking Pattern</td>
<td>Continuous unbroken vertical sections more than 400 m (1312 ft) thick can be observed, and in places, beds can be walked laterally for more than 1 km (0.6 mi). The frontal splays have a random stacking pattern, the channels are shallow and the sinuosity of the channels is low, sand-filled, have low-sinuousity with some lateral migration and occur as both single and multistory aggradational with a low relief erosional component. Channels occur both isolated and stacked in successions up to 30 m (98 ft) thick and more than 500 m (1640 ft) wide. Overbank lobes are composed of the thin-bedded architectural element and show change from tabular sheets to channels and thickening upwards packages interbedded with thin-bedded mudstones and siltstones. Slides and slumps are derived from the lateral basin slopes interfingering with the proximal parts of the fan system.</td>
</tr>
<tr>
<td>Depositional Elements</td>
<td>Reservoir elements of the Ross system include frontal-splay tabular turbidites, shallow sandy channel-fill deposits, and thickening-upward packages that formed as spillover lobes. The upper 290 m (950 ft) consists of sandier upwards, although there are no small scale thickening- or thinning-upward successions. The upper 290 m (950 ft) consists of spillover lobes. The lower 170 m (558 ft) of the Ross Formation contains tabular turbidites with no channels, with an overall tendency to become sandier upwards.</td>
</tr>
<tr>
<td>Depositional Environment</td>
<td>The depositional environment is characterized by a sand-rich basin floor fan system with frontal splays in the lower part, to channels with up to 500 m (1640 ft) wide. Overbank lobes are composed of the thin-bedded architectural element and show change from tabular sheets to channels and thickening upwards packages interbedded with thin-bedded mudstones and siltstones. Slides and slumps are derived from the lateral basin slopes interfingering with the proximal parts of the fan system.</td>
</tr>
<tr>
<td>Sedimentary Facies</td>
<td>Sand-rich basin floor fan. Overall sandier upward succession associated with an upward change from tabular sheets to channels and thickening upwards packages interbedded with thin-bedded mudstones and siltstones.</td>
</tr>
<tr>
<td>Depositional History</td>
<td>The formation was deposited in a sand-rich basin floor fan system with frontal splays in the lower part, to channels with up to 500 m (1640 ft) wide. Overbank lobes are composed of the thin-bedded architectural element and show change from tabular sheets to channels and thickening upwards packages interbedded with thin-bedded mudstones and siltstones.</td>
</tr>
<tr>
<td>Regional Setting</td>
<td>The regional setting is the Carboniferous period of the Paleozoic era, characterized by the deposition of the Ross Formation in the extensional Shannon Basin of County Clare, Western Ireland.</td>
</tr>
</tbody>
</table>

Outcrop Summary

- The Ross Formation is composed of tabular turbidites and shallow sandy channel-fill deposits.
- Channels and spillover packages are stacked and show significant palaeocurrent variability.
- The basin fills are characterized by sand-rich facies with a progradational sand-rich fan system.

Outcrop Summary

- The Ross Formation is composed of tabular turbidites and shallow sandy channel-fill deposits.
- Channels and spillover packages are stacked and show significant palaeocurrent variability.
- The basin fills are characterized by sand-rich facies with a progradational sand-rich fan system.
Sheet-form Architectural Elements

Length >300 m (>985 ft)
Thickness 145 m (475 ft)
Net/Gross 50 – 80%

Outcrop orientation for this element 315 – 135° (Figure 2)
Average paleocurrent 75° (Figure 2)

Typical facies succession Bouma A

Sand/Conglomerate Bed Architecture

Bed length range 10–>300 m (32–>985 ft)
Bed length average >300 m (>985 ft)
Bed thickness range 0.1–1.27 m (0.3–4.2 ft)
Bed thickness average 0.14 m (0.46 ft)
Texture - grain size range, average, and sorting Very fine to fine, well sorted

Shale Bed Architecture

Bed length range 10–>300 m (32–>985 ft)
Bed length average >300 m (>985 ft)
Bed thickness range 0.01–5 m (0.03–16.4 ft)
Bed thickness average ~0.10 m (~0.32 ft)

Channel-form Architectural Elements

Channel form Partial
Width 100–200 m (328–656 ft)
Thickness 5–10 m (16–32 ft)
Aspect ratio: Width/thickness 20
Net/Gross 95%

Outcrop orientation for this element 200–020° (Figure 4)
Average paleocurrent 300° (Figure 4)

Typical facies succession Massive sand, mud-conglomerate at base
Channel infill bedding architecture Massive amalgamated channel fill. Channel margin onlap. Occasional lateral accretion.

Sand/Conglomerate Bed Architecture

Bed length range NA
Bed length average NA
Bed thickness range ~0.1–0.8 m (~32–262 ft)
Bed thickness average ~0.25 m (~82 ft)
Texture - grain size range, average, and sorting Very fine to fine, well sorted
Channel-base shale drape coverage ~75%
Channel-base shale drape thickness 0–~1m (0–~3.3 ft)

Shale Bed Architecture

Bed length range NA
Bed length average NA
Bed thickness range NA
Bed thickness average NA
Figure 2. Architectural element S1: Leck Point — Sheetform element. Tabular beds deposited in the distal part of the Ross turbidite fan system.

Figure 3. Architectural element T1: Kilbaha Bay — Thin-bedded element. Sandier and thickening upward packages deposited in the middle and upper part of the Ross turbidite fan system.

Figure 4. Architectural element C1: Eastern cliff at Ballyclough of Ross — Channel element. Photo and sketch show multiple small-channel incisions marked by mudstone clast conglomerates. Paleoflow measurements show channel orientation is close to perpendicular to outcrop cliff face.
Figure 5. Clooconeen Point — Channel margin and spillover with view approximately to west. Lateral spillover to the west from C1 - Channel architectural element to T1 - Thin-bedded architectural element. White line shows channel margin surface which cuts down towards the east. Note onlap of channel fill against this erosion surface, and spillover and onlap of higher beds towards the west. The top of the channel fill passes into the top of a thickening upward package to the west.

Figure 6. Bridges of Ross — Stratigraphic upward change from the 6 m (20 ft) thick muddy slide (the Ross Slide) to undeformed T1 - Thin-bedded element (thickening and sandier upward packages) to vertical and lateral stacked channels (C1: Channel element). Sketch of photo below, note relatively similar paleoflow direction of the muddy slide and the thin-bedded sandstones above. Below the Ross Slide are planar thin-bedded sandstones.

Figure 7 (lower left photo): Cliffs below the Hill — Lateral accretion of C1 - Channel architectural element. The dark recessive interbeds are mud-clast conglomerate, these interbeds and the sandstones are gently dipping to the left at cliff top. The sandstones pinch out towards the top, and to the lower downlap surface, giving sigmoidal bed shapes. The thickness of set of dipping beds is about 6-8 m (20 - 26 ft), and the length of the set is about 200 m (656 ft). Dipping beds are interpreted as lateral accretion deposits.