

Paper VIII

Atlas of Deep-Water Outcrops AAPG Studies in Geology 56

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Ross Formation, Shannon Basin, Western Ireland

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Executive Summary

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 stratigraphic succession, make the Ross Formation well suited as an analog for sand-rich turbidite plays in passive margin basins around the world.

The lower 170 m (558 ft) of the Ross Formation contains tabular turbidites with no channels, with an overall tendency to become sandier upwards, although there are no small scale thickening- or thinning-upward successions. The upper 290 m (950 ft) consists of turbidites, commonly arranged in thickening-upward packages, and amalgamated turbidites that form channel fills that are individually up to 10 m (33 ft) thick. A few of the upper channels have an initial lateral accretion phase with interbedded sandstone and mudstone deposits, and a subsequent vertical aggradation phase with thick-bedded amalgamated deposits. As the channels filled, more turbidites spilled farther overbank. Superb outcrops show that thickening-upward packages developed when channels initially spilled muds and thin-bedded sands up to 1 km (.6 mi) overbank, followed by thick-bedded amalgamated turbidites that spilled close to the channel margins. The palaeocurrent directions associated with the amalgamated channel fills suggest a low channel sinuosity. Stacks of channels and spillover packages 25 – 40 m (82 – 131 ft) thick may show significant palaeocurrent variability at the same stratigraphic interval but at different locations. This suggests that individual channels and spillover packages were stacked into channel-spillover belts, and that the belts also followed a sinuous pattern.

Reservoir elements of the Ross system include frontal-splay tabular turbidites, shallow sandy channel-fill deposits, and thickening-upwards packages that formed as spillover lobes.

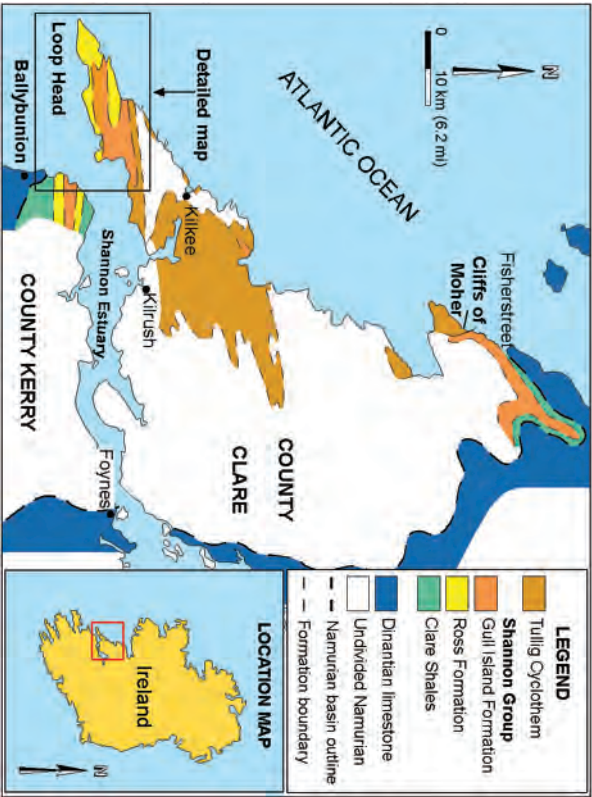


Figure 1. Top is a location map of Ireland, with rectangle showing enlarged area of County Clare. Colors mark the different Carboniferous formations, and the Ross Formation is in yellow. Below is the detailed map of Loop Head Peninsula and Ballybunion area. All areas mentioned in the text are shown.



Outcrop Summary	
Shannon Basin	
Location	Shannon Estuary
	Region/province/state
	County Clare, Western Ireland
	Country
	Ireland
Formation	Ross Formation
Age	Late Carboniferous (Namurian)
Basin Setting	Extensional basin developed during crustal extension in latest Devonian time. Elongated and confined graben geometry, possible asymmetric controlled by an underlying reactivated old structural linement. Deposition on the basin floor along the axis of the basin, onlapping the adjacent basin slopes.
Basin Size	ENE-WSW elongation, 20 km² (7.8 mi²)
General Outcrop Description and Stacking Pattern	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 chaotic units.
Depositional Setting(s) Interpretation	Progradational sand-rich fan system with frontal splays in the lower part, to channels with associated overbank lobes interbedded with few large scale slumps and slides in the upper part. The vertical development is gradual, with thin marine bands the only basin-wide correlation markers. The frontal splays have a random stacking pattern, the channels are shallow, sand-filled, have low-sinuosity 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 internal upward sandier and bed thickening trend from mudstone to interbedded thin sandstone and mudstone beds to amalgamated massive sandstones. Slides and slumps are derived from the lateral basin slopes interfingering with the proximal parts of the fan system.
Overall Outcrop Dimensions in Panel	
Length	
~ 23 m (75.5 ft)	
Thickness	
~ 460 m (1509 ft)	
Average Net/Gross	
60%	
Grain size range	
Very fine to fine grained sandstone	
Other	Superbly exposed in sea-cliffs along the Shannon Estuary and the County Clare coast. 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 (.6 mi).
Architectural Element Number on Outcrop Photo or Interpretation Panel	

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	

Thin-bed Architectural Element	T1
Length	>250 m (>820 ft)
Thickness	3 m (9.8 ft)
Net/Gross	60%
Outcrop orientation for this element	260–080°
Average paleocurrent	50°
Typical facies succession	Bouma A
Sand Bed Architecture	
Bed length range	10->250 m (32->820 ft)
Bed length average	>250 m (>820 ft)
Bed thickness range	1–100 cm (0.03–3.2 ft)
Bed thickness average	10 cm (0.32 ft)
Texture - grain size range, average, and sorting	Very fine to fine, well sorted
Shale Bed Architecture	
Bed length range	1->250 m (3.2->820 ft)
Bed length average	>250 m (>820 ft)
Bed thickness range	1–50 cm (0.03–1.64 ft)
Bed thickness average	5 cm (0.16 ft)
Analog Reservoirs or Fields	NA

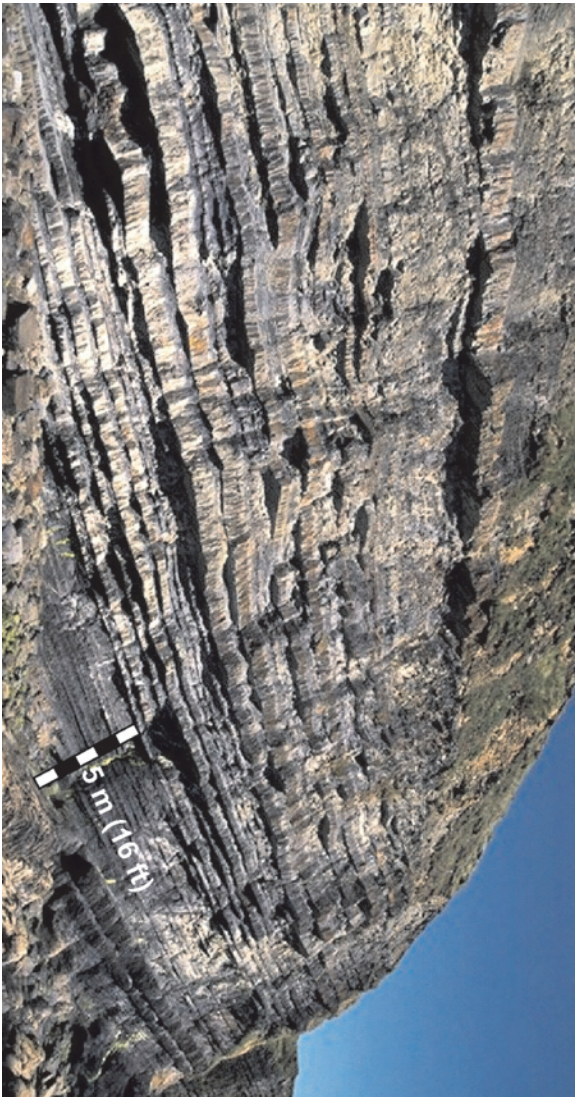


Figure 2. Architectural element S1: Leek Point — Sheelform element. Tabular beds deposited in the distal part of the Ross turbidite fan system.

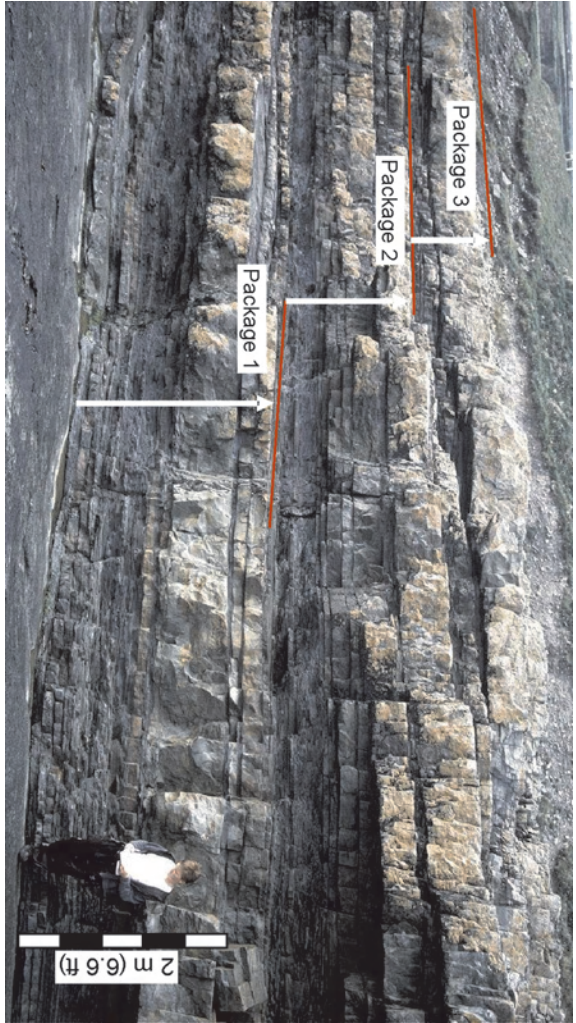


Figure 3. Architectural element T1: Kilbaha Bay — Thin-bedded element. Sandier and thickening upwards packages deposited in the middle and upper part of the Ross turbidite fan system.

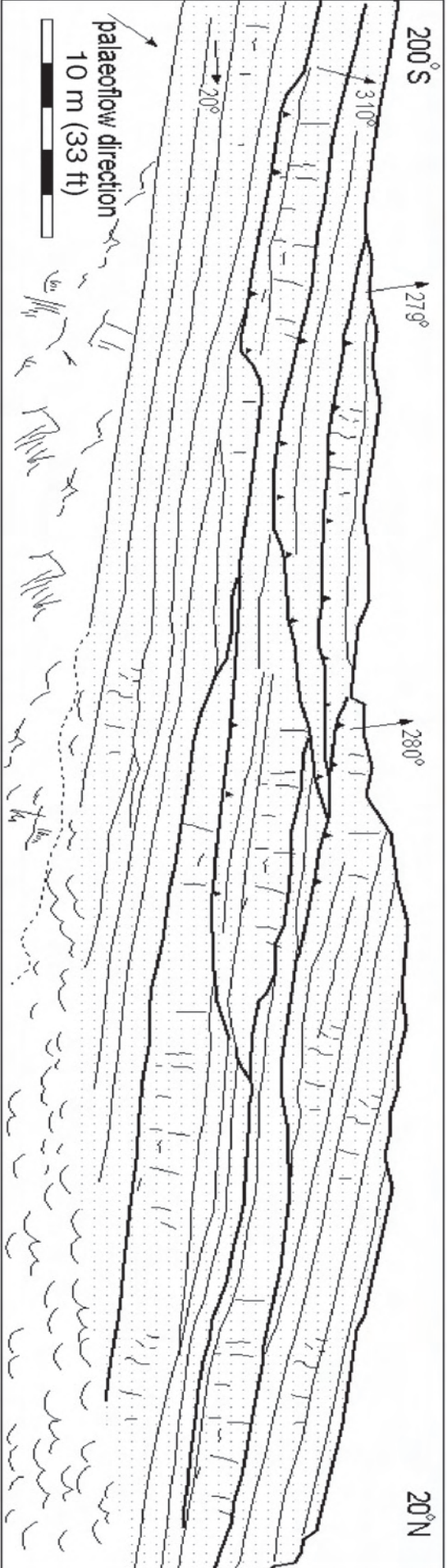
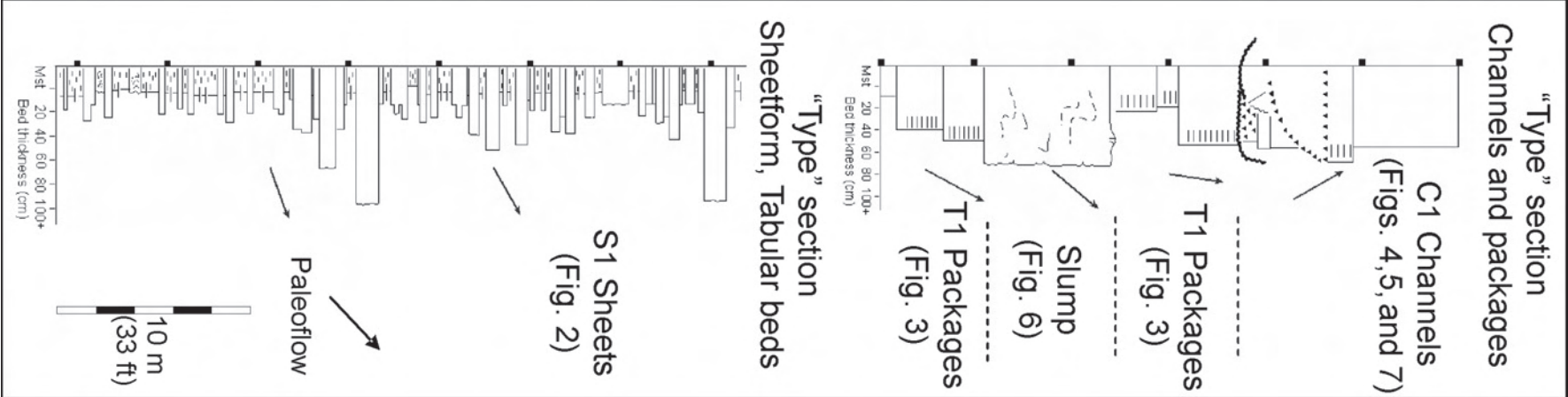


Figure 4. Architectural element C1: Eastern cliff at Bridges of Ross — Channel element. Photo and sketch show multiple small-channel incisions marked by mudstone clast conglomerates. Paleoflow measurements show channel orientation is close to perpendicular to outcrop cliff face.



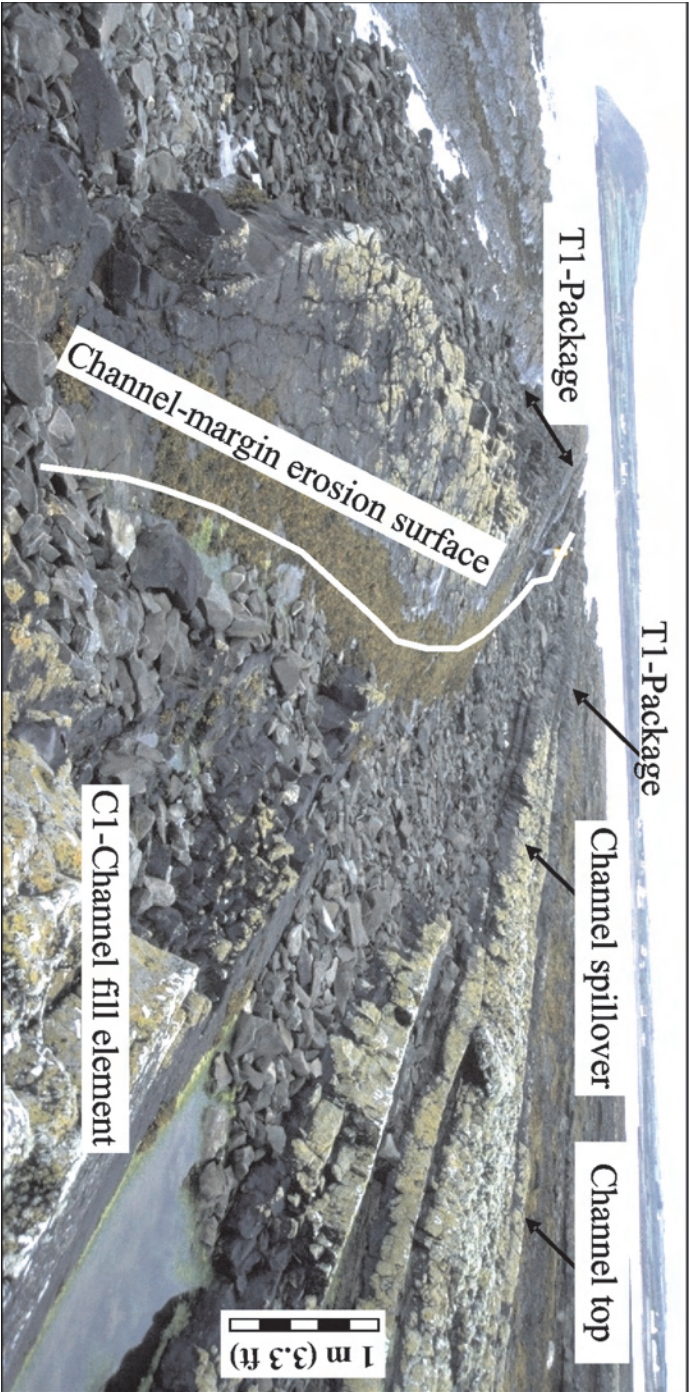


Figure 5. Clooconeen Point — Channel margin and spillover with view approximately to west. Lateral spillover to the west from C1-Channel architectural element to T1-Thin-bedded architectural element. White line shows channel margin surface which cuts down towards the east. Note onlap of channel fill 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 towards the west.

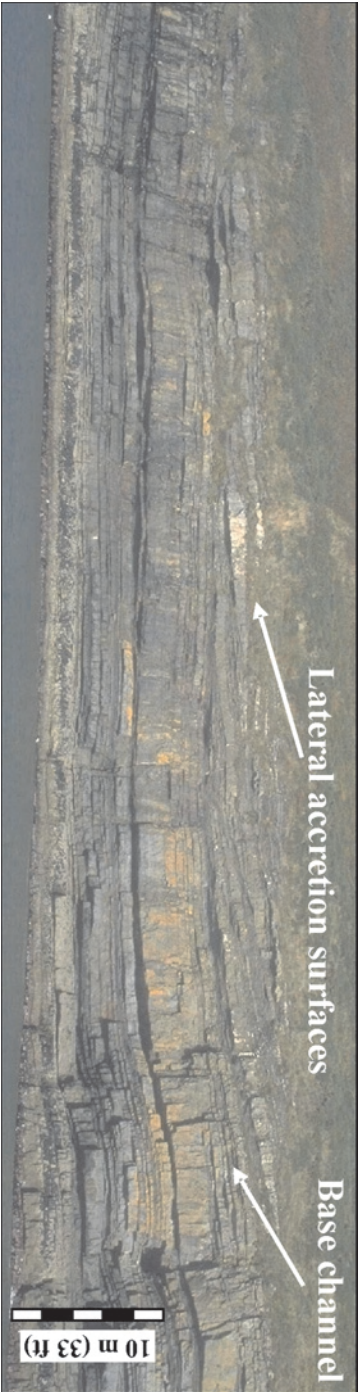


Figure 7 (lower left photo). Cliffs below Rehy Hill — Lateral accretion of a C1 - Channel. Regional bedding is horizontal. The dark recessive intervals are mud-clast conglomerate, these intervals and the sandstones are gently dipping to the left at cliff top. The sandstones pinch out toward the top, and toward 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.

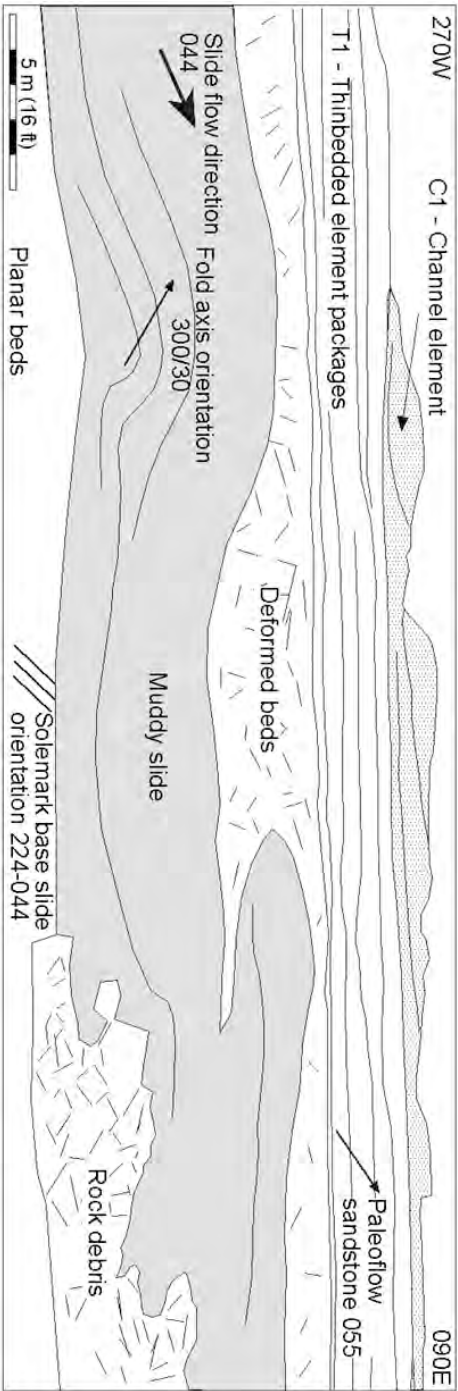


Figure 6. Bridges of Ross — Stratigraphic upward change from the 6 m (20 ft) thick muddy slide (the Ross Slide) to undeformed T1-Thin-bedded element (thickening and sandier upward packages) to vertical and lateral stacked channels (C1: Channel element). Sketch of photo below, note relatively similar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