P-4001 Quaternary ice sheet limits on the continental shelf west of Ireland.

Stephen McCarron[1*], Mudasar Saqab[2], Kieran Craven[3], Daniel Praeg[4], Benjamin Thebaudeau[5], Xavier Monteys[3]
[1]Maynooth University, Maynooth, Ireland. [2](formerly)iCRAG, UCD, Dublin, Ireland. [3]Geological Survey of Ireland, Dublin, Ireland. [4]Géoazur UMR7329 CNRS, Valbonne, France. [5]Joyce Country and Western Lakes geopark , Westport, Ireland.
* Presenting author

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Abstract: Recent investigations have shown that the continental shelf west of Ireland contains sedimentary landforms recording occupation by grounded, lobate ice sheet margins of the last British Irish Ice Sheet (BIIS) that extended from Ireland during at least the last glacial cycle. This paper reviews some of the offshore evidence of past glacial events available from high-resolution bathymetry, 2D/3D seismic datasets, and shallow sediment cores providing information on the sedimentology, rheology and age of glacigenic stratigraphic units. The available data suggest that the continental shelf has been repeatedly occupied by tidewater ice margins characterised by ice streaming, possibly since the mid-Pleistocene transition. The offshore record provides as yet incomplete information on the extent and timing of glaciation from multiple centres of dispersal in Ireland. The dynamics of former ice sheets in Ireland, downwind of the climatically important central North Atlantic region, makes them of wider interest in the study of partially marine based ice sheet-ocean interactions in rapidly changing environments.

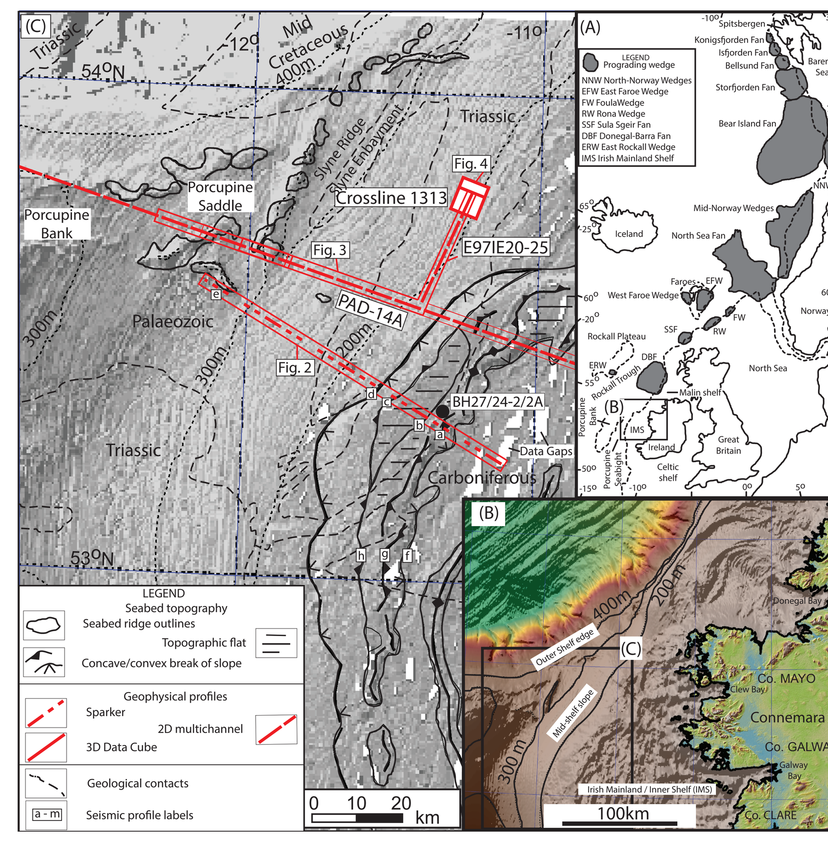


Fig. 1. (A) Plio-Pleistocene sediment wedges on the NW European Atlantic margin (after Dahlgren et al. 2005).

(B) The bathymetry of the western Irish Shelf. Data sources: Irish National Seabed Survey (INSS) multibeam echosounder (MBES) data for water depths >200 m and in Donegal Bay, and GEBCO 2008 0.5 arc sec in <200m water depth.

(C) A hillshaded relief image of the study area rendered from INSS MBES data showing: lines of examined seismic reflection datasets; summary bedrock geology (after Naylor et al. 1999); the location of BH27/24-2,2A; prominent seabed topography mapped from seismic profiles, INSS MBES data and OLEX bathymetric databases (Thébaudeau et al. 2015).

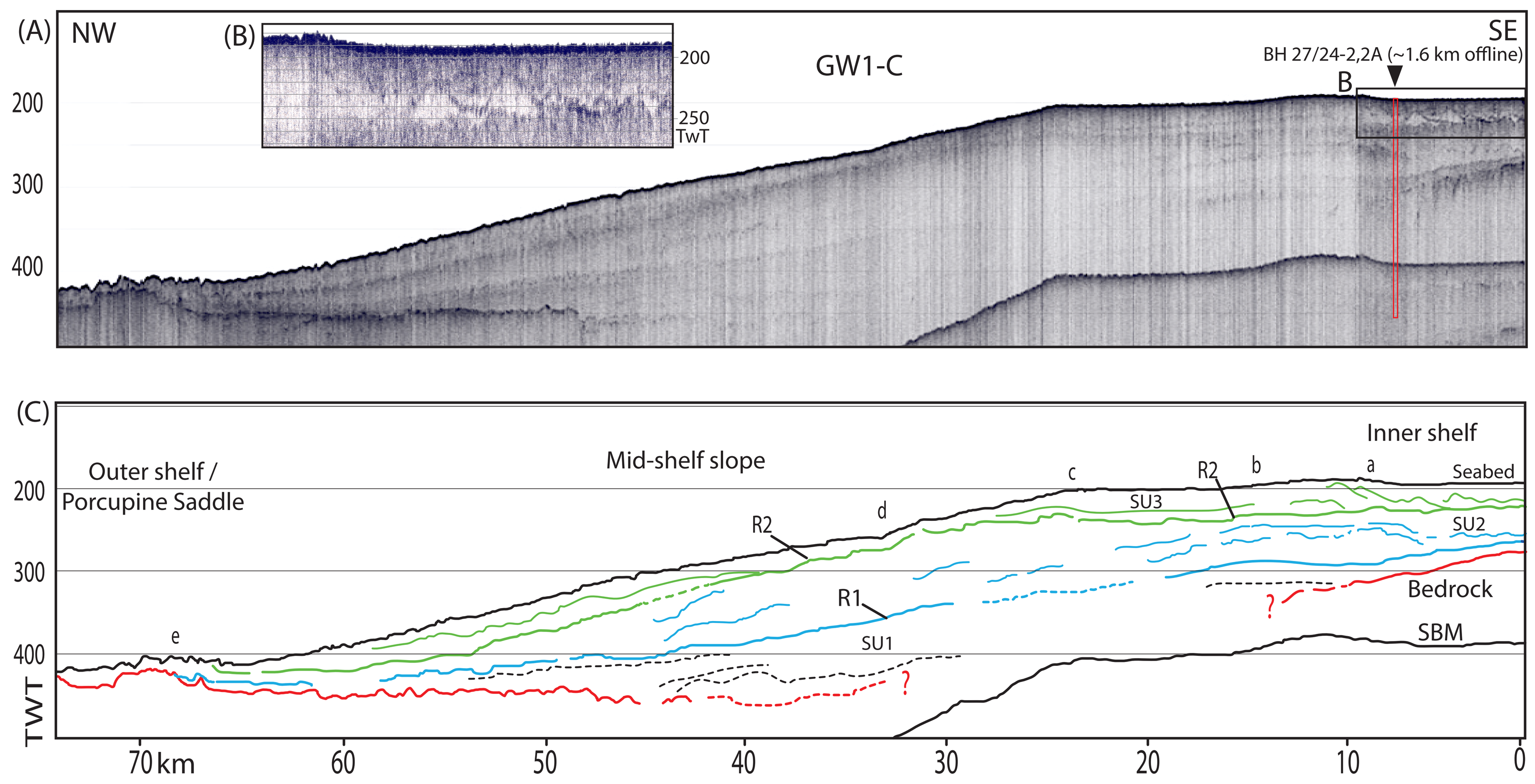


Fig. 2. (A) Sparker seismic reflection profile GW1-C. Labeled locations: (a-b) a prominent (circa 20 m high) seabed ridge cresting at 195 ms / 146 m water depth; (c)inner shelf break at ~200 ms / ~150m water depth; (d) a notch/inflexion point on the mid-shelf slope (e) a seabed ridge on the bathymetric plateau of the Porcupine Saddle; (c-e) mid-shelf slope.

(B) Detail of the inner shelf seismic architecture showing prominent, mounded, eastward offlapping subsidiary reflectors within SU3.

(C) Interpretative sketch of Panel A. Note (i) an uneven bedrock surface on the inner shelf, two prominent cross-shelf intra-fan reflectors (R1 & R2), three seismic stratigraphic units (SU1-3).

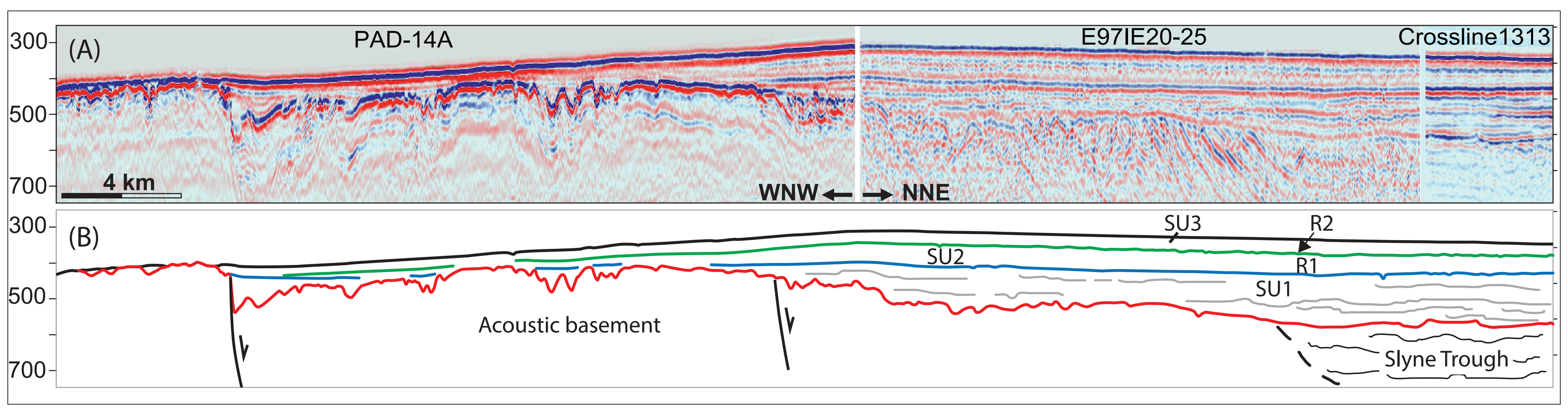


Figure 3. (A) An arbitrary seismic profile across three data sources spanning (L-R) the Porcupine Saddle eastwards into the Slyne Trough. Crossline-1313 is part of the 3D 2000-08 seismic cube (Fig. 4).

(B) Interpretation of principal reflectors on Panel A, showing the lateral continuity of R1 & R2 and their onlap westward onto a fault-controlled basement high.

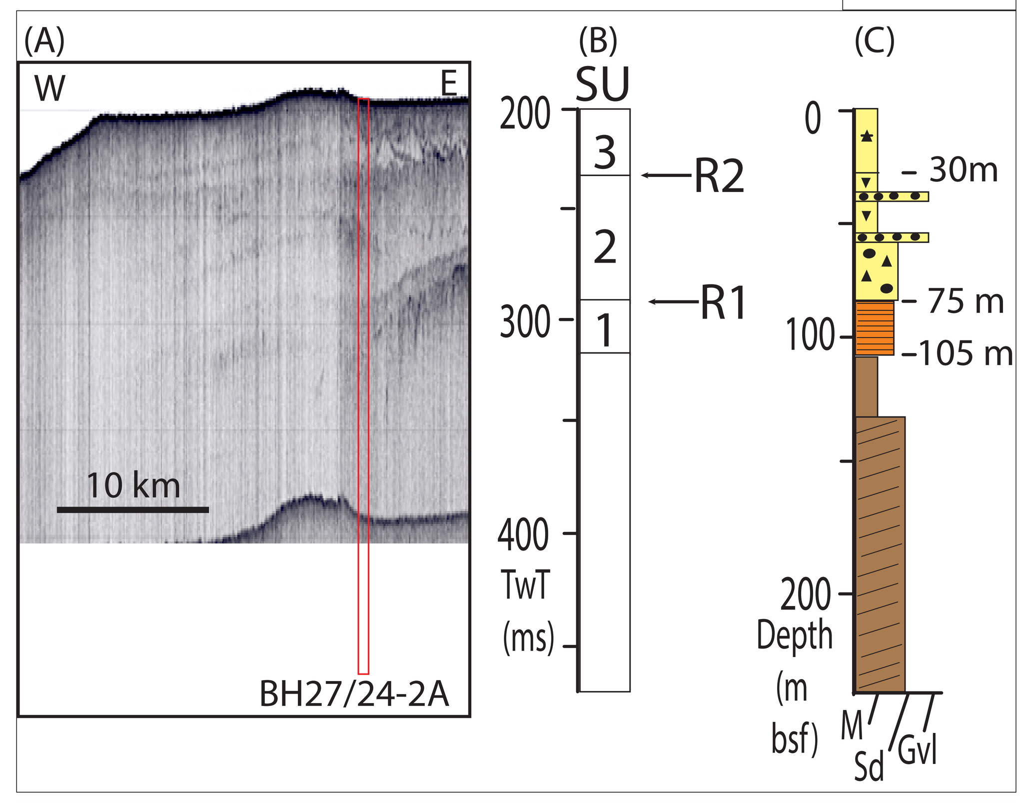
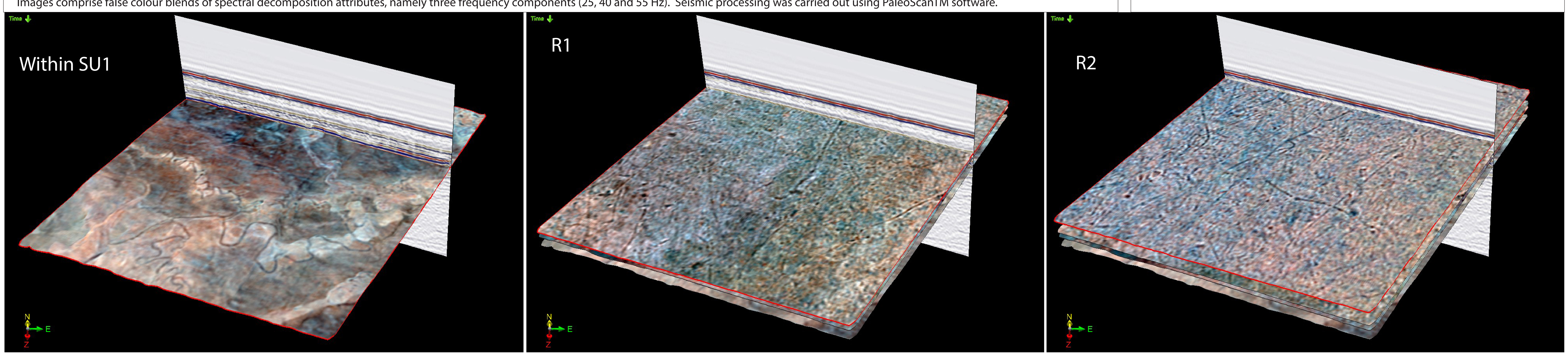


Fig. 3. (A) Offline location of borehole 27/24-2 and 2A relative to the GW1-C sparker seismic profile on the inner shelf west of Ireland.

(B) Inferred correlation of GW1-C data to units and surfaces observed in boreholes 27/24-2 and 2A (Fugro, 1994), using a seismic velocity of 1680 m/s (McCarron et al., 2018).

(C) Summary cartoon stratigraphy of boreholes 27/24-2 and 2A (Fugro, 1994). See Figure 6 for a more detailed description of sediment units.

Fig. 4. Seismic reflection data from a 3D survey (2000-08) covering ~990 km² of the mid-shelf slope (Fig. 1 for location). Horizonal data bins of 25 * 12.5 m, vertical resolution of approx. 10 m. Images comprise false colour blends of spectral decomposition attributes, namely three frequency components (25, 40 and 55 Hz). Seismic processing was carried out using PaleoScanTM software.



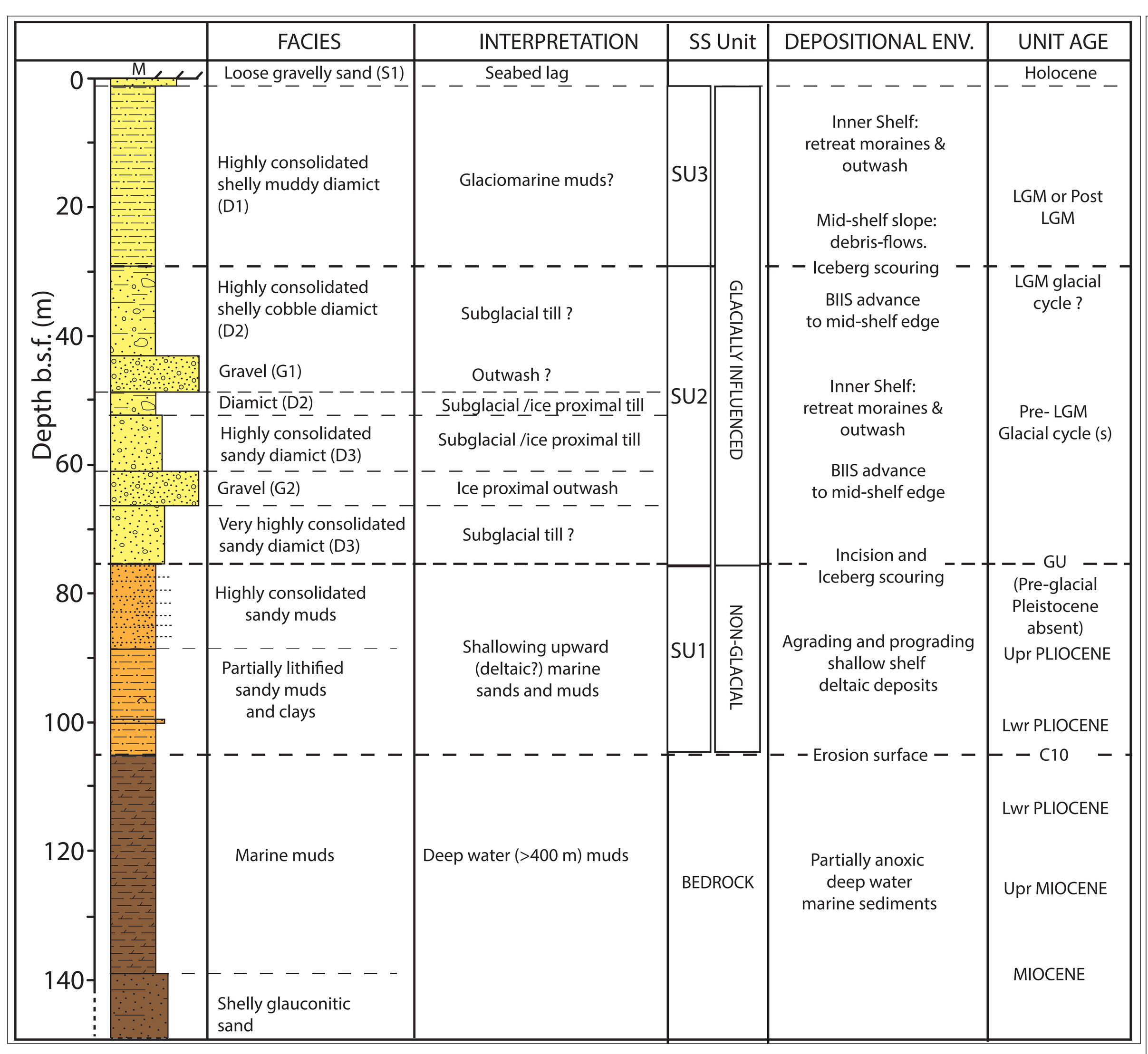


Fig. 6. Interpretation of the sedimentology and chronostratigraphy of boreholes 27/24-2 and 2A (Fugro, 1994), with a proposed correlation to the seismic architecture (Seismic Stratigraphic Unit), and interpretations of Connemara Fan depositional environments and SS unit ages (McCarron et al., 2018).

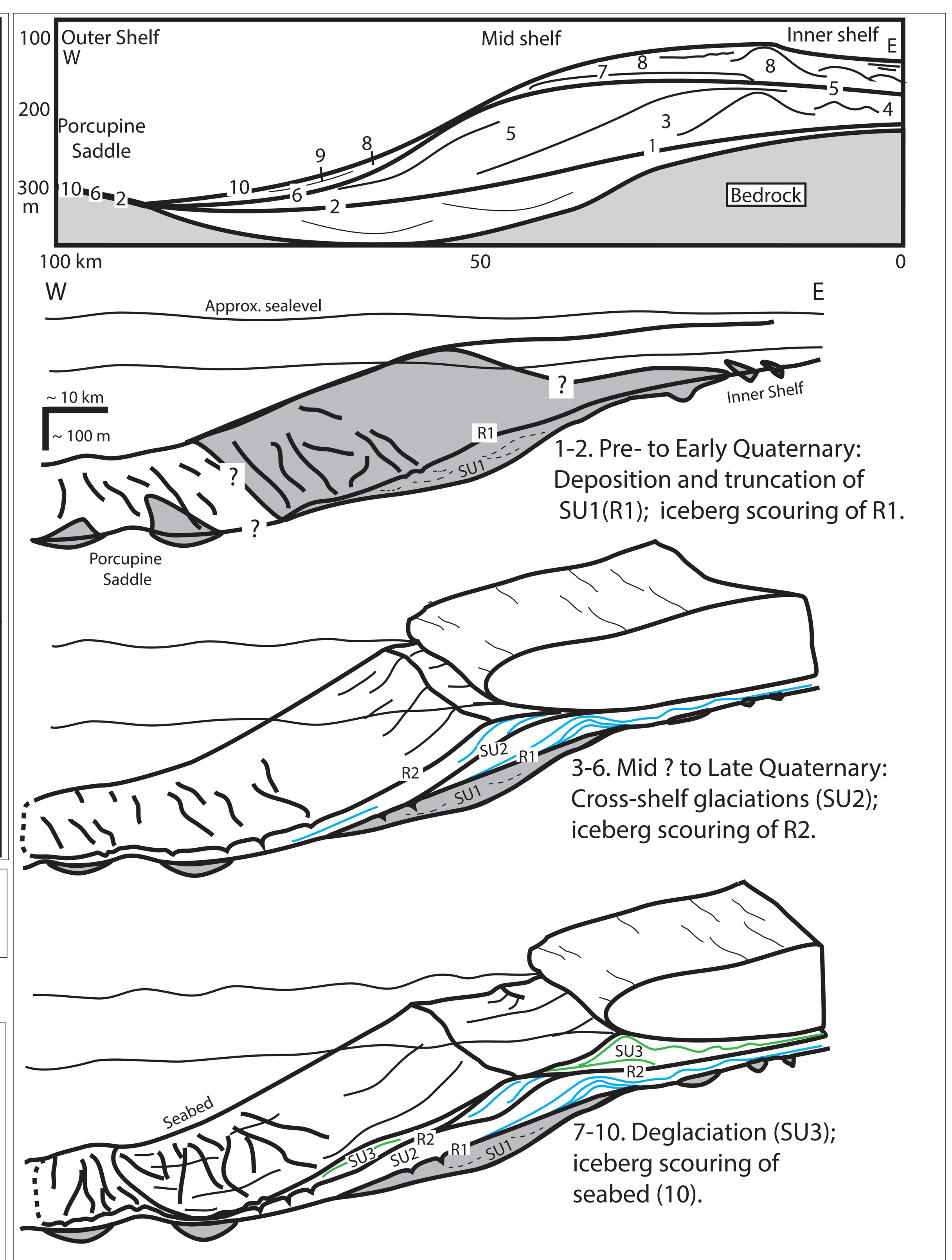


Fig. 7. (*opposite*) A proposed cartoon chronology of events recorded in the Connemara Fan (McCarron et al. 2018).

1 Truncation of Pliocene sediments (SU1) along R1.

2 Iceberg scouring of R1, pre-dating Pleistocene cross shelf ice extension west of Ireland.

3 Initial deposition phases of SU2 during cross shelf glaciation west of Ireland as moraines and a "till delta" on the inner shelf; preservation of underlying iceberg scours on mid-shelf slope.

4 Minor morainic ridges within SU2 formed during a period of deglaciation.

5 Deposition of upper parts of SU2 during ice sheet extension across the inner shelf and subglacial erosion along R2. MIS 2 and/or older in age.

6 Major phase of deglaciation. Iceberg scouring of R2 on the mid-shelf slope. MIS 2 and/or older in age.

Fig. 7 (*continued*) 7-8 Moraines and mid-shelf slope drape over R2 formed during either: An ice marginal still-stand during overall deglaciation , OR maximum westward extent of an ice sheet. MIS 2 (lLGM) in age.

9 Slide/mass movement of sediment drape on mid-shelf slope. MIS 2 (post-LGM) in age.

10 Iceberg scouring of seabed. MIS 2 (post-LGM) in age.

Discussion: Aggradation and progradation of The Connemara Fan (CF) began with Pliocene deltaic sedimentation (SU1) followed by erosion and iceberg scouring of this unit (R1) possibly before and into the early Quaternary (McCarron et al, 2018). The CF contains two glacigenic units (SU2 and 3) which are separated by a iceberg scoured marine surface (R2) under the mid-shelf slope and a subglacial erosion surface on the inner shelf. These two units are inferred to represent pre-LGM- (SU2) and LGM- (SU3) aged units respectively.

Preservation of scours on R1 & R2 (Fig. 4) implies that grounded glaciation extents were restricted to inner shelf limits, as in other areas of the western Irish Shelf (Clark et al, 2012, Ó Cofaigh et al, 2019). The extent and water depth of grounded ice limits are critical criteria in evaluations of last BIIS models (e.g. Hubbard, et al, 2009). More widely, the CF extends the southern latitudinal range of directly glacially fed fans on the north-east Atlantic margin.

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