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The geology of Svalbard: structural, stratigraphic and geomorphic response to the formation of two passive margins

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Svalbard is located at the junction of the North Atlantic and Arctic margins, preserves an onshore structural and stratigraphic record that spans from the Devonian to the Cenozoic and records several phases of extension characterized by different tectonic transport vectors. Contractional events such as the Devonian, so-called 'Svalbardian′ fold phase and the formation of an Early Cenozoic fold and thrust belt have locally modified the evidence for extension and basin formation. However, several generations of extensional structures and associated, tectonically controlled basins are displayed in world-class exposures at different locations in the archipelago.
At present, we focus on the following onshore features related to extension and margin formation:
1. Late-post orogenic extension: An extensional detachment and metamorphic core complex was recently identified by us in northwestern Spitsbergen, involving re-interpretation of tectonic contacts interpreted previously as thrusts. The undulating extensional detachment appears to have controlled 'Old Red′ basin formation from the Early into the Late Devonian. The core complex evolved into a N-S trending anticline with flanks that eventually became the locus of strike-slip and normal faulting. Some of these faults were demonstrably reactivated, and we propose that the Devonian structural template became important in controlling the location of later rift structures that developed from the Carboniferous onwards.
2. Carboniferous rifting: Normal faulting controlled sedimentation in Carboniferous basins including an up to 2 km deep, coastal/marine half-graben with mixed siliclastic, carbonate and evaporite fill exposed in Central Spitsbergen. The Billefjorden Fault zone (BFZ) reactivates an older, N-S trending Devonian reverse fault, and coarse siliclastic debris was transported into the basin along relay ramps that developed between the normally reactivated strands of the BFZ. Monoclinal folds, interpreted previously as Tertiary compressional features, were recently re-interpreted by two of the present authors as extensional fault-growth monoclines, similar to structures described by others from the Gulf of Suez.
3. Late Triassic normal faulting: Spectacular outcrops of syntectonic half-graben basins occur in the lower parts of the Late Triassic Deltaic DeGeerdal formation on Edge Island. The intricate architecture of sandbodies revealed by the half-graben basins can be used to decipher in detail the relationships between accommodation and sediment supply. The half-graben reveal several periods of hangingwall-directed progradation of sandy units over prodelta shales, catastrophic deposition of massive massflow sandstone wedges and the subsequent burial of these under marine shales or channel sandstone units.
4. Differential uplift, incision and landscape formation. Northwards incision of stratigraphy due to differential uplift in the Cretaceous, incision of widespread geomorphic surfaces into Palaeogene strata and the uplift of these to a 1000 metres altitude show that significant vertical movements accompanied the evolution of the margins. Pronounced variations in landscape across the archipelago and even a quaternary volcano situated on a neotectonic fault-line attests further to a large research potential with respect to the onshore response to margin formation in the Arctic and Northernmost North Atlantic.