

**THE VAKKEJOKK BRECCIA, NORTHERNMOST SWEDEN: A CAMBRIAN ANALOGUE TO THE PROXIMAL EJECTA LAYER AND RESURGE DEPOSITS AT THE ORDOVICIAN LOCKNE MARINE-TARGET CRATER.**

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**Introduction:** Along the steep southern slope of Mount Vaivancohkka immediately north of lake Torneträsk in the Swedish arctic there are extensive exposures of an up to c. 25 m thick, polymict breccia, known as the Vakkejokk Breccia [1, 2]. It can be traced for c. 10 km, often as a prominent terrace along the slope. The Vakkejokk Breccia was previously interpreted as a tillite, slump deposit or tectonic breccia [for a review see 2 and 3], but Nielsen & Schovsbo [3] found the previous explanations unsatisfactory due to the rather local distribution of the breccia and in particular the occurrence of very large basement clasts, and suggested the breccia to be impact related. Its Early Cambrian age is well constrained, as it is intercalated in a shallow marine Lower Cambrian sedimentary succession (Dominopolian Regional Stage), corresponding to an absolute age of c. 520 Ma. Our reinvestigation of the Vakkejokk Breccia during three field expeditions (2012, 2014, and 2015) has demonstrated that the spectacular breccia most likely is a proximal ejecta layer. The breccia shows many similarities with the ejecta- and water resurge-related units described from the well-studied Lockne Crater, Central Sweden, which formed in a similar layered target [e.g., 4]. Thus, a comparison is natural.

**Results and discussion:** Along the 7 km long main section, where the breccia is semi-continuously exposed, the breccia sequence can be divided into the subunits i) an up to 20m thick, strongly disturbed lower polymict breccia with sporadic crystalline mega-clasts (LPB), ii) an about 1-3 metre-thick, commonly normally graded, crystalline-rich, polymict breccia (GPB), followed with either transitional or sharp contact by iii) a <30cm thick quartz-rich sandstone ("top sandstone", TS). In a few places, the sandstone is overlain by a <30cm thick conglomerate ("top conglomerate", TC). The large (sometimes mega-scale) clasts of the LPB consists mostly of angular crystalline basement rock, themselves brecciated (i.e., forming a "breccia-in-breccia"). Contorted clasts of bedded sandstone are also common, indicating a pre-mobilization semi-consolidated state, all of which is surrounded by a muddy matrix. The LPB is resting with gradual transition on more or less strongly disturbed Lower Cambrian sedimentary strata, which complicates an exact estimate of the LPB thickness. In what is interpreted to be the most proximal parts of the ejecta layer the sizes of clasts derived from the crystalline basement reach c. 50 meters. Petrographic evidence for an impact scenario in the form of planar deformation features (PDFs) in quartz are frequent in the GPB as well as in the TS [5].

After the emplacement of the breccia the silty background sedimentation was rapidly resumed; these strata are referred to as the Red and Green Siltstone member. In progressively more distal parts of the ejecta layer, the development of the LPB is less complete due to fewer of the large basement clasts and it is here better described as only slightly disturbed strata. However, the metre-thick GPB continues for several kilometers, but with decreasing clast sizes. Outcropping in a river stream on the other side of the mountain massif some 15 km NE of the main section is a 70 cm thick sandstone bed in the same stratigraphic position as the Vakkejokk Breccia. It contains sporadic cm-size sedimentary and severely fractured crystalline basement clasts as well as quartz grains with PDFs [5], confirming its relation with the Vakkejokk Breccia. Other similar distant occurrences of coeval sandbeds are currently investigated.

The stratigraphic position of the Vakkejokk Breccia suggests an impact in a shallow-marine environment (~20 m water depth). We interpret the LPB to be para-autochthonous as a result of ejecta- (i.e., solid and water) bombardment of the sedimentary strata surrounding the impact crater in analogy with the Ynntjärnen Breccia at the Lockne Crater [4]. The GPB is likely an allochthonous breccia representing ejecta that obtained a vertical size-sorting when fragments were transported back to the crater by a water resurge in analogy with the Lockne Breccia at Lockne [4]. The overlying TS shows similarities to the Loftarstone fine-grained resurge deposits at Lockne [4]. The sporadic TC may indicate local variations in the flow regime, or local slumps from an elevated crater rim exposed to wave action. The extent and thickness of the ejecta layer as well as the dimensions of the crystalline megaclasts in the proximal parts indicate a final crater size of about 2-4 km most likely located under the Mount Vaivancohkka Caledonian overthrust complex. The well-preserved ejecta layer suggests that the crater may be equally well preserved, and the marine target setting may have led to a post impact Cambrian infill sequence of great stratigraphic interest in this part of Scandinavia.

**References:** [1] Kulling O. 1964. *Sveriges Geologiska Undersökning* Ba 19: 1–166 (In Swedish). [2] Thelander T. 1982. *Sveriges Geologiska Undersökning* C 789: 1–41. [3] Nielsen A.T. and Schovsbo N.H. 2011. *Earth-Science Reviews* 107: 207-310. [4] Lindström M. et al. 2008. *The Geological Society of America Special Paper* 437: 43-54. [5] Alwmark et al. 2016. 79th Annual Meeting of The Meteoritical Society, submitted.