

Assessing chemical compositions of Cr-spinel as a tool for provenance based on a regional comparison of Upper Triassic sandstones from the Barents Shelf

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The mineral chromian spinel (Cr-spinel) varies in its chemical composition according to petrogenesis and metamorphic alteration, as well as being the only common mafic-ultramafic mineral considered stable in sediments. These qualities make the mineral interesting in order to identify and differentiate potential contributions from mafic-ultramafic source rocks in sandstone provenance studies. Studies of detrital Cr-spinel have previously focused on major and minor element compositions. The addition of Cr-spinel trace element analysis seems to add significant source-sensitive information. In this study, we have performed major-, minor- and trace element analysis of detrital Cr-spinel from the Triassic Snadd and De Geerdalen formations from selected locations in the Barents Sea (shallow cores) and Svalbard (outcrops). Notably, the Cr-spinel major element compositions show remarkably similar variations across the large regional area, favouring an ophiolite-associated Cr-spinel origin. An ophiolite related source interpretation fits well with an ultimate source in the Uralide Orogeny, as suggested in other provenance studies of these formations. Trace element compositions do, however, reveal a more complex evolution in the Cr-spinel source. A relative enrichment of Zn, Co, Mn seen together with a relative depletion of Ga, Ni indicate a metamorphic modification of the Cr-spinel chemistry. As detrital trace element compositions of Cr-spinel is a relatively novel field of study, there are several challenges concerning data interpretation. Assessments of the impact of erosion, sedimentary sorting, diagenetic stability and metamorphic alterations, are all challenges that can provide new information to future Cr-spinel provenance studies.

Anatomy of the evaporite accumulation and salt wall evolution in the Tiddlybanken Basin, southeastern Norwegian Barents Sea

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Reprocessed 2D seismic reflection profiles and well data are utilized to study the Tiddlybanken Basin and Signalhorn Dome in the southeastern Norwegian Barents Sea. Interpretation of selected seismic profiles, time-thickness maps and conceptual models are presented to highlight the control of pre-salt graben architecture on the facies distribution within the layered evaporitic sequences, passive diapirism along strike of the salt wall, and the link between reactive diapirism and pre-salt structures.

The Carboniferous graben architecture is subdivided into three half-graben units that are separated by a NW-SE trending horst and an overlapping transfer zone. The arcuate geometry of the horst is believed to be the effect of the pre-existing Timanian basement grain. The overlapping transfer zone created a barrier that affected the facies distribution and thickness within the layered evaporitic sequences. During the early Triassic to earliest Cretaceous, the northwestern part of the Tiddlybanken Basin was developed due to passive diapirism caused by the halite lithology within the layered evaporitic sequences. The central and southeastern part of the salt wall was not recovered from the pillow stage due to lack of halite lithology in the deepest evaporitic sequence. In the late Triassic, far-field stresses from the Novaya-Zemlya fold-and-thrust belt reactivated the half-graben structures and formed the Signalhorn Dome, rejuvenated the NW part of the salt wall and affected the sedimentation rates in the southeastern broad basin. The salt wall, the Signalhorn Dome and the underlying Carboniferous graben structures were again reactivated in post-Early Cretaceous time, likely in response to regional compressional stresses related to the early Cenozoic transpressional Eureka/Spitsbergen orogeny. During this phase, the NW and SE parts of the salt wall evolved due to reactive diapirism; however, salt reactivation was minimized towards the transfer zone beneath the center of the salt wall.

Description and crystal structure of three new barium beryllophosphates

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Three new Ba-bearing beryllophosphates were recently described in pegmatitic geological contexts, showing exciting crystal structures. Minjiangite, $\text{BaBe}_2\text{P}_2\text{O}_8$, was discovered in the Nanping No. 31 pegmatite, Fujian Province, China. It crystallizes in space group $P6/mmm$ ($a = 5.028(1)$ and $b = 7.466(1)$ Å), and shows a phyllophosphate structure consisting of double layers of tetrahedra, which contain both Be and P in a 1:1 ratio. Inside the layers, the $(\text{Be,P})\text{O}_4$ tetrahedra form six-membered rings by sharing corners. The Ba atoms are located in very regular 12-coordinated polyhedra and connect two successive double layers (Rao et al., 2015; Dal Bo et al., 2014).

Wilancookite, $(\text{Ba,K,Na})_8(\text{Ba,Li,[]})_6\text{Be}_{24}\text{P}_{24}\text{O}_{96}\cdot 32\text{H}_2\text{O}$, forms tiny rhombododecahedral crystals in the Lavra Ponte do Piauí pegmatite, Minas Gerais, Brazil. Its crystal structure ($I23$, $a = 13.5398(2)$ Å) is identical to those of pahasapaite and of synthetic zeolite RHO (Hatert et al., 2017); the framework is based on corner-sharing BeO_4 and PO_4 tetrahedra forming a large cavity in which occur Ba atoms and water molecules. Three different types of rings are building the cavity: eight-membered rings parallel to (100), six-membered rings parallel to (111), and four-membered rings parallel to (110).

More recently, limousinite, $\text{BaCa}[\text{Be}_4\text{P}_4\text{O}_{16}]\cdot 6\text{H}_2\text{O}$, was discovered in the Vilatte-Haute pegmatite, Limousin, France. This beryllophosphate, which crystallizes in space group $P2_1/c$ ($a = 9.4958(4)$, $b = 13.6758(4)$, $c = 13.4696(4)$ Å, $\beta = 90.398(3)^\circ$), shows a zeolite framework identical to that of philipsite, based on corner-sharing BeO_4 and PO_4 tetrahedra forming inter-connected 4-membered and 8-membered rings. Large cages within this zeolite framework contain Ba, Ca and water molecules; calcium is distributed over the two Ca1 and Ca2 positions, with occupancies reaching 0.648(9) and 0.345(11), respectively. Ba occurs at a very large crystallographic site, with a complex morphology and a (11 + 1) coordination; the Ca1 site shows a (7 + 1) coordination, with a morphology corresponding to a very distorted cube; the Ca2 site shows a 7 coordination with a morphology of very distorted pentagonal bipyramid. This mineral species is the third known zeolite-type phosphate.

References:

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Modeling the effects of carbon release from the Central Atlantic Magmatic Province (CAMP)

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The Central Atlantic Magmatic Province (CAMP), the end-Triassic mass extinction (ETE), and major carbon cycle disruptions occurred synchronously around the Triassic-Jurassic (T-J) boundary (~ 201 Ma). The carbon cycle perturbations include significant increases in atmospheric CO_2 concentrations ($p\text{CO}_2$) and negative carbon isotope excursions (CIEs), the latter attesting to input of isotopically depleted carbon into the ocean-atmosphere system. Parts of the plumbing system of CAMP intruded into volatile-rich sedimentary basins in northern Brazil, likely leading to significant generation of thermogenic carbon. Here we use carbon cycle modeling to explore the effects of carbon release from CAMP on atmospheric $p\text{CO}_2$ and oceanic $\delta^{13}\text{C}$. While mantle-derived carbon alone cannot account for the negative CIEs, an extremely isotopically depleted carbon source (e.g. methane clathrates) is not required. We propose a new model for the T-J boundary carbon cycle perturbations, based on realistic scenarios for the evolution of CAMP, including the newest U-Pb geochronology from both the flood basalts and the sub-volcanics. We find that organic-rich shale affected by contact metamorphism around CAMP sills represents a likely source for ^{13}C -depleted carbon, and that the release of mixed mantle- and sediment-derived carbon can explain the observed T-J boundary proxy data. Our results strengthen the case for an active involvement of CAMP in the end-Triassic crisis, and that the sub-volcanic part of a LIP represents a key driver for global carbon cycle perturbations.

Metamorphic P-T paths of Eastern Finnmark: Towards a better understanding of the tectono-metamorphic evolution of the Kalak Nappe Complex

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Garnet in rocks of low to medium metamorphic grade may record important information about the pressure – temperature (P-T) conditions experienced during its growth. In the case of the Kalak