

Holocene Paleoclimatic interpretations from shallow sediment cores from a freshwater lake in eastern Antarctica

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Lake Priyadarshini is one of the largest lakes in the Schirmacher Range, a group of low-lying hills of 50-200 m height, of eastern Antarctica. With a total area of 0.75 km², Lake Priyadarshini is closest to the Indian Station, Maitri. The shallow sediment cores from Lake Priyadarshini are characterized by the dominance of silty clay fractions throughout indicating more or less uniform sediment supply, mostly through settling of suspended load. Mineralogically, detrital quartz and feldspar represent the principal allogenic phases, along with illite, chlorite with minor amount of mixed-layered minerals. Absence of typical clay minerals reflects periglacial environment of the Antarctic region with a short summer period and limited moisture supply, which has not encouraged chemical weathering processes.

The elemental concentration of Fe, Mn, Pb, Cd, Cu, and Zn in the allogenic fraction of core sediments seems to reflect the post-depositional processes including those initiated by microorganisms or bacteria viz. oxidation, reduction, or substitution with methyl groups. The cyclic profiles of these elements shows some correlation with organic matter content, as most of these metals are probably bound with organic matter forming organo-metallic complexes. Radio-isotope measurements on sediment cores using the high resolution gamma ray spectrometer show ¹³⁷Cs activity only in the top most section and the rapid decrease with depth appears to indicate a very low sedimentation rate. ²¹⁰Pb profile seems to be highly correlated with the ²²⁶Ra activity and it seems to indicate migration of ²¹⁰Pb produced in-situ from the decay of earlier deposited ²²⁶Ra through anaerobic bacterial reductions to methyl derivatives. The radiocarbon age of the sediment sample (20-50 cm) from Priyadarshini lake was calculated on ¹⁴C measurement as 7190±300 years B.P. Based on ¹³⁷Cs and ¹⁴C, the rate of sedimentation in the lake works out to be 0.05 to 0.35 mm/yr, which is consistent with the sedimentological studies.

Inferences about climatic changes have been made based on elemental distribution, ¹⁴C date and data from pollen distribution. The variation of redox conditions of the lake basin can be inferred from the distribution of Fe and Mn concentrations. At a core depth of 35-40 cm corresponding to a radiocarbon age of around 7kyr, low concentrations of Fe and Mn indicate reducing conditions. The pollen data also indicate a shallow lake condition during this period (Phase I) characterized by scanty terrestrial vegetation constituted of grasses together with scattered distributed elements of *Chenopodiaceae*/*Amaranthaceae*, moderate frequency of *Cosmarium*-a fresh-water alga, coupled with preponderance of *Acritarch* - a shallow fresh/marine water dweller. This phase is followed by an oxidising phase (Phase - II) marked by increase in elemental concentrations of Fe, Mn, Cu and Zn. A climatic change is also indicated by vegetational composition during this period characterized by very significant improvement of grass vegetation, increased frequencies of *Cosmarium* and simultaneous decline in *Acritarch*. All these evidences point to inception of warm climate and a wider expanse of lake in consequence of retreat of ice. This phase is followed by a sharp decline in grasses and disappearance of most of the herbaceous elements and this change is also marked in the decrease of elemental concentrations (Phase III). The near-surface increase in elemental concentration marks the amelioration of climate during recent times and corresponds very well with the improvement in *Cosmarium*.

Zircon in the Val Gardena sandstone from the Ziri region, W Slovenia

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In Slovenia, the largest continuous belt of clastic rocks of the Val Gardena Formation of Permian age extends in the Ziri region, between Cerkno and Smrecje belonging to the Idrija - Ziri Overthrust structure.

The Val Gardena Formation has drawn attention of many geologists with the occurrences of uranium and copper in ore concentrations. MLAKAR (1979 - 1983, 1985) geologically mapped the Ziri region and subdivided the Val Gardena Formation into six members: Brebovnica Member, Hobovše Member, Koprivnik Member, Zala Member, Škofje Member, Doberca Member. The thickness of the Val Gardena Formation locally varies between 200 and 1750 m and reaches its maximum in the region of Zirovski vrh. The Val Gardena Formation is underlain by dark grey mostly shaly clastic rocks of attributed Carboniferous age. The upper part of these beds might be of Lower Permian age. The overlying beds consist of the Upper Permian carbonate rocks.

Geologists dealing with the Val Gardena Formation, especially in the lower uranium bearing part (Brebovnica Member), had difficulties with detailed correlation. With little success we tried to improve the lithofacial correlation using the mineral composition of light and heavy fraction. Finally, zircon was chosen as a discrimination mineral. It was one of the most frequent components in the relatively quickly changeable suite of heavy minerals and was present in all samples. The form of zircon is relatively easy to observe, determine, and quantify, but it depends on numerous physical and chemical conditions, which are influenced by crystallisation conditions.

In the Val Gardena sandstone the zircon grains are euhedral and rounded. The examined euhedral grains of zircon were classified into 37 typological forms from the middle and lower part of the Pupin's typological classification (PUPIN 1980), which comprises 64 different forms. Beside more or less symmetrical zircon grains also grains with two typological forms and complex intergrowths were found.

Chemical composition data for different typological forms collected so far do not allow a reliable conclusion on the relation between the chemical composition of zircon and its crystal forms. Nevertheless, some differences in the content of Hf, Y, Th, U, and Fe substituting Zr in the crystal structure between different types of zircon were detected.

For further quantitative evaluation only the typological forms (S7, S8, S9, P2, S12, S13, S14, S17, S18 S19, S20, P4, S22, S23, S24) having the relative frequencies exceeding 1.5 % of the entire zircon form population were considered. The correlation among different types of zircon was relatively low. Somewhat higher correlation between the typological forms was within seven determined clusters.

Clusters of cases (samples) defined by the relative frequencies of the typological forms of zircon show, on the basis of the available data, that there is no possibility for more detailed and confident correlation within the members of the Val Gardena Formation. However, the members of the Val Gardena Formation are statistically different on the level $p < 0.05$. The typological forms S8, S23, P4, P2, S22, S18, S7, S19 and S14 make the most significant contribution to their discrimination. The lithostratigraphic members can be discriminated and correlated with the mean certainty of 82 %.

Finally, we tried to interpret types of igneous rocks in the source area according to the relative frequencies of the crystal forms of zircon population in the Val Gardena sandstone. The most frequent zircon types S19, S24, and interpretation data from PUPIN (1980, 1985) indicate the prevailing influence of orogenic type igneous

rocks of Ca-alkaline and K-Ca-alkaline compositions. The modal, lithic grains and pebbles composition of the Val Gardena sandstone and conglomerate support such interpretation.

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Fans in the NE - Tauern Window (Austria)

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The northeastern end of the Penninic Tauern Window between the Fusch valley in the west and the Kleinarl valley in the east is built up by a variable sequence of rocks. In the north the dominating rocktype is the Klammkalk, an elongated body, thick in the east up to at least 1000 meters; it thins out dramatically between Rauris valley and Fusch valley. Within the Klammkalk, but increasing towards the south, intercalations of black and green phyllites are common. Between Kleinarl valley and Rauris valley there is a large, approximately up to 1000 m thick intercalation of black phyllites, quartzitic schists and finegrained breccias, separating a thinner southern layer of Klammkalk from the thicker northern layer. South from the main body of Klammkalk the rocks are dominated by lens-like dolomite breccias, black phyllites, chlorite-quartz-schists and last not least turbiditic sandstones with phyllites. The dolomite breccias and complexes of turbiditic sandstones form also elongated lenses several kilometers long. The southern continuation is built up by black phyllites.

The age of the whole sequence is still debatable. Finding of scarce crinoids (not determinable) in Klammkalk suggest Jurassic to Lower Cretaceous age. From black phyllites associated with the southern Klammkalk and black phyllites associated with the southernmost quartzites and breccias spores of Early to maximum Middle Cretaceous age were described.

Our investigations concentrated on the lens-shaped dolomitic breccias and the turbiditic sandstones. The breccias form several individual lens-shaped elongated layers, which merge in the vicinity of the Großarl valley into one relatively thick breccia complex. The individual layers consist of several thinner beds usually up to 50 cm in thickness. The boundaries are generally flat but are occasionally uneven, probably representing channelfills. In some cases beds are contorted, that could be best explained as effect of syndimentary slumping or sliding. Most of them are matrix supported breccias and display a gradation. As a conclusion we assume on the base of the observed structures that rocks represent massflow deposits and created a local channelized submarine fan. The dolomitic breccias are concentrated in the east, between the Kleinarl valley and the Gastein valley, farther to the west they occur also. However, they create only local lenses becoming smaller towards the west, but locally increasing again. Complimentary with the decrease of the breccias towards the west we observe an increase in turbiditic sandstones. They vary from generally medium bedded to thick bedded. Quite often the clastic layers display a sharp, uneven lower boundary with small, broad channels and the gradate upwards into mudstones. Some of the beds display a gradation of grains. In many cases it is possible to detect an original upright position. In some cases we observed bottom current structures such as flood marks and dragmarks (PREY 1975, 1977). The current structures suggest a source area to the SW.

A similar lens-like distribution of dolomite breccias with also similar internal structures can be observed in the Matrei Zone

between the Matreier Tauern valley in the west and the Leiter valley in the east. They are in analogy to the breccias in the northern part again intercalated by black phyllites. Turbiditic sandstones were not found until now, but in comparable position chlorite bearing quartzites occur highly folded and recrystallized. HÄUSLER (1988) described from the Hippold nappe and the Radstadt nappe very similar lithologies and structures, which he interpreted as fans.

Our findings suggest that the clastic sediments in the northeastern Tauern Window formed along a large passive continental margin to the south of the Penninic Zone, which was the deposition area of the Northern Calcareous Alps and of the Lower Austroalpine deposits of the Radstädter Tauern: This margin was dissected by large listric faults forming local extensional basins separating various swells and eventually floored by oceanic crust (e.g. Reckner, Matrei Zone). On both sides of the Tauern Window one can find big, often elongated blocks of dolomite and limestone. At least a part of them represent olistolites derived from the southern carbonate platform of the Northern Calcareous Alps. The clastic fans were probably supplied from uplifted and tilted blocks from the same area. In that time the basinal, pelagic or hemipelagic sediments were represented by the black shales and sandy marls.

Reservoirqualitäts-Vorhersage im nordwestdeutschen Rotliegenden

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Schlechte Reservoirqualität (R_Q) ist häufige Ursache für Fehlbohrungen im nordwestdeutschen Rotliegenden. Innerhalb maturaer Kohlenwasserstoff-Provinzen wie dem nordwestdeutschen Rotliegend-Becken ist es deshalb zwingend notwendig, existierende Modelle und Strategien so weiterzuentwickeln, um Risiko und damit auch die Kosten bei der Erschließung des Restpotentials zu minimieren. Das Poster präsentiert 2 Play-Modelle und zur RQ-Vorhersage im nordwestdeutschen Rotliegenden:

1. Das „Paläocharge-Retention-Modell“: Während primäre Lithofazies lediglich die Ablagerung eines potentiellen Netto-Reservoirs bestimmen, wird die Erhaltung des Porenraums durch quasi-Inhibierung schädigender diagenetischer Prozesse innerhalb der KW-Säule eines Paläofeldes kontrolliert. Das vorgestellte Modell erklärt die Entfärbung primär rot gefärbter, gut sortierter Sandsteine im NW-deutschen Rotliegenden durch KW-induzierte Fe³⁺-reduktion, oft verbunden mit Erhaltung des fröhdiagenetischen Tonminerals Chlorit. Der Übergang zwischen grauen Sandsteinen und roten, hämatitischen Sandsteinen ist oft stratigraphisch diskonform und mit einer RQ-Verschlechterung verbunden. Reservoirbereiche mit Chloritdiagenese sind i.d.R. durch eine horizontale Grenze von unterlagernden illitisierten Abfolgen abgetrennt. Die Übergangszone beider Bereiche ist durch Chlorit/Illit-Vergesellschaftungen repräsentiert. Die meisten Sonden des nördlichen Fairways produzieren aus chloritischen Graufolgen. KW-Remigration/ Leakage führt dagegen zur diagenetischen Schädigung ehemals gasgefüllter Träger, oft verbunden mit intensivem authigenen Illitwachstum.

Wichtige Faktoren der RQ-Vorhersagestrategie im durch das „Paläocharge-Retention-Modell“ beschriebenen Play sind ein möglichst exaktes 3D-Abbild von Temperatur- und Charge-Geschichte, verbunden mit fundierten Vorstellungen zur Struktur- und Permeabilitätsvorhersage. Eine geostatistische Permeabilitätsvorhersage (aus seismischen Attribut- oder Impedanzkarten) ist daher nur unter Einbezug der Paläocharge-relevanten Daten aus Referenzbohrungen sinnvoll.