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Volcanism and reef development in the Devonian: a case study from the southern shelf of the Old Red Continent (Rheinisches Schiefergebirge, Lahn syncline, Germany)

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The Rheinisches Schiefergebirge belongs to the Rheno-Hercynian Zone representig a part of the Variscan fold belt of Europe which resulted from the collision of Africa, Baltica, Laurentia, and intervening microplates in early Palaeozoic times (FRANKE *et al*. 1995, TAIT *et al*. 2000). The Rheinisches Schiefergebirge is generally assigned to the micro-continent Avalonia which was separated from Gondwana in the Early Ordovician. The collision between Avalonia and Baltica occurred in Late Ordovician – Early Silurian times, and Avalonia collided with Laurentia in the Silurian forming Laurussia (“Old Red Continent”). The Rheinisches Schiefergebirge formed part the southern margin of the Old Red Continent (ORC) flooded by an epicontinental shelf sea. The ORC delivered siliciclastic material, which was transported by rivers from the continent on the shelf during Devonian times, especially during the Early Devonian, where several thousand meters of siliciclastic material has been accumulated. The shelf area was divided into different mobile sedimentary troughs and swells, and Devonian sedimentation was triggered by synsedimentary tectonics, global sea-level changes, and mainly submarine volcanic activities.

The volcanic acitivities being concentrated in the Lahn-Dill area can be assigned to two cycles, a Devonian and a Carboniferous one (NESBOR 2004). These comprised several phases each, with interruptions altogether lasting for about 45 Ma. The products of the individual volcanic edifices piled up to several hundred metres. Their asymmetrical development to the regional strike was due to the rise and outpouring of the magmas along the fault planes of half grabens (MOE 2000). The occurrence of quite a few volcanic centres during Givetian-Frasnian phase led to a distinct facies develpoment, refered to as central, proximal and distal facies (NESBOR *et al*. 1993). The central facies is defined by the multitude of flows, sheet flows as well as pillow lavas. The amount of volcaniclastic material grows with rising distance from the eruption centre whereby alternating flows (including sills) and volcaniclastics characterise the proximal facies. The volcaniclastics consist of pillow breccias, pillow fragment breccias, and hyaloclastics and can be found in situ as well as further downslope transported as volcaniclastic debris flows. Associated with the proximal facies realm is the development of iron ore of the Lahn-Dill type (e.g., REQUADT 1990, FLICK *et al*. 1990, LIPPERT & FLICK 1998) which has been of economic importance until almost the end of the last century. The distal facies misses any flows or sills and is characterized by well bedded epiclastic layers. Ocassionally, the submarine volcanoes piled up above the sea level giving rise to volcanic islands. These are proved by base surge and pyroclastic fall deposits which can be compared to modern analogues.

Interruptions of the volcanic activities, however, especially their ending during the early Frasnian was favourable for the overgrowth by reef limestones. Reef development east of the river Rhine was influenced to a much greater degree by patterns of local tectonism, uplift, block faulting and volcanism than in the Ardenne-Eifel area, west of the river Rhine. Main reefs builders in the Middle Devonian sequences are stromatoporoids and corals. They occur in different facies settings ranging from deeper shelf to intertidal showing a wide range of shapes which can be interpreted in terms of various sedimentological environments. The thickness of reef structures is variable depending on their morphology. Generally, morphological categories, such as banks, biostromal complexes, isolated complexes (e.g., atolls) and carbonate buildups can be observed in the southern Rheinisches Schiefergebirge (e.g., KREBS 1967, BUGGISCH & FLÜGEL 1992, BRAUN *et al*. 1994, KÖNIGSHOF 2007). In terms of conodont stratigraphy reefs in the southern Rheinisches Schiefergebirge began to flourish during the Middle Devonian *varcus*-subzone in the Givetian and lasted until the late *falsiovalis*-subzone in the Frasnian.

We have combined geochemical and palaeontological datasets from the literature as well as new data in order to receive a better understanding of the interaction between volcanism and reef growth in deeper water settings within the Rheinisches Schiefergebirge. The presentation will focus on the reconstruction of depositional and palaeoecological conditions of volcanic island induced reef growth based on case studies from the Lahn syncline.

References

BRAUN, R., OETKEN, S., KÖNIGSHOF, P., KORNDER, L. & WEHRMANN, A. (1994): Development and biofacies of reef-influenced carbonates (central Lahn Syncline, Rheinisches Schiefergebirge). – Courier Forschungsinstitut Senckenberg, 169: 351-386.

BUGGISCH, W. & FLÜGEL, E. (1992): Mittel- bis oberdevonische Karbonate auf Blatt Weilburg (Rheinisches Schiefergebirge) und in Randgebieten: Initialstadien der Riffentwicklung auf Vulkanschwellen. – Geologisches Jahrbuch Hessen, 120: 77-97.

FLICK, H., NESBOR, H.-D. & BEHNISCH, R. (1990): Iron ore of the Lahn-Dill type formed by diagenetic seeping of pyroclastic sequences – a case study on the Schalstein section at Gänsberg (Weilburg). – Geologische Rundschau, 79, 401-415.

FRANKE, W., DALLMEYER, R.D. & WEBER, K. (1995): XI Geodynamic Evolution. – *In*: DALLMEYER, R.D., FRANKE, W. & WEBER, K. (eds): Pre-Permian Geology of Central and Eastern Europe. Springer Verlag: 579-593.

KÖNIGSHOF, P. (2007): Mittel- bis oberdevonische Riffkarbonate in der Lahnmulde (südliches Rheinisches Schiefergebirge). – Jahresbericht Mitteilungen oberrheinischer geologischer Verein, N.F. 89: 261-272.

KREBS, W. (1967): Reef development in the eastern Rhenish Slate mountains, Germany. – *In*: OSWALD, D.H. (ed.): Internat. Symp. Devonian System. – Alberta Society Petrology Geology, 2: 295-306.

LIPPERT, H.-J. & FLICK, H. (1998): Vulkano-sedimentäre Roteisenerze vom Lahn-Dill-Typ. – *In*: KIRNBAUER, T. (ed.): Geologie und hydrothermale Mineralisation im rechtsrheinischen Schiefergebirge. – Jahrbuch Nassauischer Verein Naturkunde So-Band, 1: 121-128.

NESBOR, H.-D. (2004): Paläozoischer Intraplattenvulkanismus im östlichen Rheinischen Schiefergebirge – Magmenentwicklung und zeitlicher Ablauf. – Geologisches Jahrbuch Hessen, 131: 145-182.

NESBOR, H.-D., BUGGISCH, W., FLICK, H., HORN, M. & LIPPERT, H.-J. (1983): Vulkanismus im Devon des Rhenoherzynikums. Fazielle und paläogeographische Entwicklung vulkanisch geprägter mariner Becken am Beispiel des Lahn-Dill-Gebietes. – Geologisches Jahrbuch Hessen, 98: 3-87.

REQUADT, H. (1990): Blatt 5613 Schaumburg. – Erläuterungen Geologische Karte Rheinland-Pfalz 1:25000, 2. Auflage, 1- 212.

TAIT, J., SCHÄTZ, M., BACHTADSE, V. & SOFFEL, H. (2000): Palaeomagnetism and Palaeozoic palaeogeography of Gondwana and European Variscan Belt. – *In*: FRANKE, W., HAAK, V., ONCKEN, O. & TANNER, D. (eds): Orogenic processes: quantification and modelling in the Variscan Belt. – Geological Society Special Publication, 179: 21-34.