Sediment- und isotopengeochemische Proxies für die aktuellen Änderungen der Fluß- und Umweltdynamik des Niederrheins

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Das Abfluß-Regime des Niederrheins hat sich in den letzten Jahrhunderten deutlich verändert. So lassen sich parallel zu den in Mitteleuropa nachgewiesenen klimatischen Veränderungen (Zunahme der mittleren Jahrestemperatur von 0,6-0,7 °C in den letzten 100 Jahren) ansteigende Tendenzen des mittleren Abflußes (MQ) an verschiedenen Rheinpegeln nachweisen. Die mit der Temperaturerhöhung auftretenden Niederschlagsumverteilungen führten in den letzten Jahren dazu, daß besonders in den Wintermonaten (z. B. im Dezember '93 und Januar '95) extreme Hochwässer in den Einzugsgebieten des Mittel- und Niederrheins auftraten. Es kann erwartet werden, daß – gekoppelt mit der großräumigen klimatischen Entwicklung – Hochwasser-Ereignisse im Rhein-Einzugsgebiet künftig eher noch zunehmen werden.
Im Rahmen des Sonderforschungsbereiches 419 an der Universität zu Köln (Teilbereich B 4) werden gezielt hydrologisch-geochemische und sedimentologische Methoden angewandt, um einzelne Abflußereignisse und die entsprechenden Prozeß-Gefüge unter den sich ändernden klimatischen und anthropogenen Randparametern erfassen zu können. Kritisch gegenübergestellt werden natürliche Steuerungsfaktoren (z. B. Regionalklima) und anthropogen bedingte Veränderungen (z. B. Schadstoff-Ein- und -Austrag). Sowohl Rheinwasser-Proben, als auch die mitgeführte Schwebfracht und Schalencarbonate ausgewählter Süßwassermollusken werden untersucht. Wichtige umweltsensitive Parameter sind das Kalk-Kohlensäure-Gleichgewicht und die Sauerstoff-Isotopen-Signaturen ($\delta^{18}O$) des Rheinwassers, die Kohlenstoff-Isotopen-Verhältnisse ($\delta^{13}C$) des gelösten anorganischen Kohlenstoffs (DIC) und der Schalencarbonate, sowie die geogenen, bzw. anthropogenen Element-Zusammensetzungen im Wasser und in der Schwebfracht. Einzelne Hochwasser können hinsichtlich ihrer Genese typisiert und der mechanisch-chemische Stoffaustrag quantitativ und qualitativ erfaßt werden.

Geochemical investigation of the lacustrine Messelformation (Borehole Prinz von Hessen): Evidence for highfrequency climate fluctuations in the Eocene?

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The Messelformation was deposited in a number of small lake basins (up to 1 km in diameter) during the middle Eocene in Frankfurt-Darmstadt area. It dominantly consists of oil shales and is known best from its type locality (Grube Messel near Darmstadt), where paleontological investigations have recovered a large number of exceptionally well preserved fossils. Eventhough extensive knowledge exists on the biota of the Messelformation, much less is known about the lake systems in which the biota were preserved. In the course of a scientific drilling campaign (1998-2000) several smaller lakes containing facies equivalents of the Messelformation were investigated. The largest of these structures is located on the area of the former oil shale mine Prinz von Hessen. During the drilling campaign approximately 60 meters of oil shale with interbedded coal deposits were recovered. In order to reconstruct the depositional environment and its development in time, high resolution geochemical logs (TOC, $\delta^{13}C_{org}$, hydrogen index, total sulfur content, color variation, natural gamma) were established. The results show, that the lake system has experienced a complex filling history with significant variation in the water budget, leading to high frequency sedimentary cycles which are interpreted to reflect local climate fluctuations. The sedimentary fill recovered at Prinz von Hessen differs significantly from the record at the type locality at Grube Messel and indicates the presence of several independent lake systems which were not interconnected.

Investigation of the late Oligocene Kärlicher Blauton, Neuwied Basin (Rheinlandpfalz): Evidence for highfrequency variations in sediment composition from logging data

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The Oligocene Kärlicher Blauton of the Neuwied Basin was deposited in a lacustrine basin, whose maximum extension was in excess of 10 km in diameter. The Blauton consits of kaolinite and smectite rich claystones with varying amounts of goethite and organic matter. The thickness of the Kärlicher Blauton varies considerably within the former lake basin (5 to 11 m), depending on proximity to the former shore line. In order to be able correlate cores from different positions within the basin, two cores Schmidtenhöhe and Rübenacher Höhe (property of the Geological Survey Rheinlandpfalz) were logged with a hand held gamma ray szintillometer, for magnetic susceptibility and with photo spectrometer to detect color variations. Logging characteristics allowed to subdivide the otherwise uniform unit into three subunits, thus improving the stratigraphic resolution considerably.
High resolution logging (<5 cm) by gamma ray yielded a cyclic pattern. Spectral analysis of the logs resulted in one power maximum at one cycle per meter and several power maxima at lower frequencies. The power maxima show ratios typical for orbital frequencies in the Milankovitch band (100 ka, 40 ka and 20 ka). Attempts to resolve the time covered by the cycles detected are currently on the way utilizing the magnetic reversal pattern of the late Oligocene and a dated tuff which caps the Blauton as a time marker. We thus expect to be able to present a time model with a resolution of <20 ka, which can be utilized in further stratigraphic investigations.

Geochemical signature and related climatic-oceanographic processes: The proposed "Oceanic Anoxic Event 1B (Lower Albian)" at Site 417D, North Atlantic Ocean, testing the fertility hypothesis

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The proposed lower Albian OAE 1B is investigated in a deep water (3800 m paleo-water depth) open ocean environment at Site 417D, western North Atlantic Ocean. Redox cycles, which contain black shale intervals and occur in the lower Albian *M. gracilis* radiolarian

biozone are investigated in order to show processes and climate associated controlling factors during the deposition of the lower Albian OAE 1B. The black shale intervals are characterized by the enhanced accumulation and preservation of marine derived organic matter as determined by Rock-Eval pyrolysis and organic petrology. The presence of laminated sediments, the relationships between organic carbon, iron and total sulfur, pyrite size analysis and trace metal enrichment indicate the periodic prevalence of anoxic conditions in the pore waters which may have extended at times into the bottom waters. Changes in the mineralogical composition throughout the OAE 1B interval, i.e. quartz content and clay mineral assemblage, result in the variation of the major element chemistry and are probably related to cyclic climatic changes in Northern Africa combined with a flooding of coastal lowlands during an overall transgressive phase in the lower Albian. The observed geochemical signatures on different scales demonstrate a genetic link between the climate system on land and processes in the deep ocean during the deposition of the OAE 1B in deep water environments of the western North Atlantic.

Organic matter from the ejecta blanket of the Ries crater, southern Germany: Detecting thermal effects related to the impact?

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Organic matter in sediments comprises a sensitive monitor for past thermal conditions. Dispersively distributed particulate organic matter (kerogen) reacts on increasing temperatures through the conversion of solid organic matter into liquids (e.g. hydrocarbons). This transformation process is accompanied by compositional changes of the residual solid organic matter mainly caused by the loss of hydrogen, carbon and oxygen.

The energy released during shock wave metamorphism of sedimentary strata caused by an impact event is known to generate shock induced temperatures ranging from a few degrees centigrade up to 1200 °C, depending on the intensity of shock wave metamorphism. This sudden rise in temperature is expected to leave traces in the residual sedimentary organic matter surviving the impact event.

In order to evaluate temperature induced effects on organic matter in association with an impact event, we investigated organic matter rich clasts from the ejecta blanket of the Ries impact, which occurred approximately 14.7 million years ago.

The sedimentary strata deposited in the Ries area ranges from Permian to Tertiary in age. One stratigraphic interval, the Jurassic Posidonia Shale, which consists of black shales, is known to be particularly rich in organic matter of marine origin. Fragments of the Posidonia Shale were incorporated in the ejecta (polymictic breccia) of the Ries impact. We collected samples of Posidonia Shale fragments of the ejecta blanket, from quarries at Harburg, Aumühle and Gundelsheim, which are located within and close to the impact crater. In addition samples from a natural outcrop of the Posidonia Shale at Hesselberg, near Wittelshofen, approximately 10km outside of the crater rim were studied. The samples were analyzed for organic carbon content, inorganic carbon content and sulfur content. The composition and degree of thermal stress on the solid organic matter was determined by pyrolytic techniques (Rock Eval Pyrolysis).

Our results show a continuous decrease in organic carbon content, carbonate content and sulfur content of the Posidonia Shale samples when comparing results from sampling localities successively closer to the crater center. This decrease in the investigated bulk parameters is accompanied by a drop in pyrolysis yields. We interpret the observed regional pattern as an expression of the temperature field during the impact event.

Sediment transport at the upper slope of the Sesoko fringing reef, Okinawa, Japan

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Living and death assemblages of benthic foraminiferal species were compared at a NW-Pacific island slope. Two transects with different morphology were chosen, one demonstrating decreasing, the other slightly increasing steepness. Intensities of depth transport could be estimated by measuring differences between distribution parameters of living individuals and empty tests in combination with grain-size parameters of other bioclasts. Three factors were shown to induce depth transport:

1) traction intensities caused by offshore bottom currents or the frequent tropical cyclones that cross the investigation area,
2) slope steepness, and
3) differences in test buoyancies.

The complex slope topography in connection with the exposition of the coast to tropical storms leads to sediment input from surrounding shallow areas. Sediment from backreef regions is transported into the fore reef during the waning storm, while relict sediments are reworked in the deeper slope during these episodic events. Both factors, in combination with down-slope transport and slope inclination, can be demonstrated as important factors explaining sediment distribution on a fore-reef slope.

Der Stubensandstein im Süddeutschen Keuper: Reservoir-/Aquifer-Charakterisierung und klimagesteuerte Sedimentationsdynamik

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Das süddeutsche Keuperbecken eignet sich durch seine vom offenen Meer abgeschlossene Lage, sein flaches Relief und durch wahrscheinlich nur geringe tektonische Bewegungen in idealer Weise dazu den Einfluß des Klimas auf die Ablagerungsdynamik zu untersuchen.

Das Arbeitsgebiet umfasst Mittelwürttemberg bis Franken, der Daten-Schwerpunkt liegt dabei in Zentral-Württemberg. Die Datenbasis umfasst 12 Großaufschlüssen mit einer Wandfläche bis zu 20.000 m^2 pro Aufschluß, 5 Einzelbohrungen, 1 Bohrungscluster mit 6 Einzelbohrungen und 2 Bohrungscluster mit jeweils ca. 20 Einzelbohrungen.

Die Arbeitsweise orientiert sich am Aufschluß-Analog-Konzept, welches seit Jahren in der Erdölindustrie angewandt wird, um in Aufschlüssen Vergleichsdaten für dasselbe Ablagerungsmilieu in tief versenkten, nicht direkt zugänglichen Schichten zu erhalten (z. B. BRYANT & FLINT 1993, MIALL & TYLER 1991). In den letzten Jahren findet dieser Ansatz auch zunehmend Interesse in der Hydrogeologie, die zur Vorhersage von fluid-flow Eigenschaften und für numerische Simulationen präzise Angaben über Heterogenitäten und Verteilung der Porosität und Permeabilität benötigt (z. B. FRASER & DAVIS 1998, KOLTERMANN & GORELIK 1996). Die Poroperm-Eigenschaften lassen sich auf Grund des Verständnisses der Ablagerungsprozesse und durch Charakterisieren der sedimentären Einheiten besser vorhersagen (HORNUNG &