UP 10: Ozeanographie

Time: Thursday 17:00–19:00 Location: M/SR3

UP 10.1 Thu 17:00 M/SR3

The role of shallow ground water ^{3}He/^{4}He ratios in geothermal energy potential and fault zone characterisation — •Florian Freundt[1], Sami Al Najem[2], Gerhard Schmidt[2], Werner Aeschbach-Hertig[1], Margot Isenbeck-Schröter[2], and Michael Kraml[3] — [1]Institute of Environmental Physics, Heidelberg University — [2]Institute of Earth Sciences, Heidelberg University — [3]GeoThermal Engineering GmbH

Large-scale geothermal energy production relies on extensive characterization of the target fault system: its spatial location as well as its hydraulic permeability. Current geophysical methods (e.g. 3D reflection seismics) offer only a limited insight in hydraulic permeability, which the TRACE project aims to expand by applying a multi tracer analysis on shallow ground water above the target zone. ^{3}He/^{4}He ratios are one important part of this approach, offering a tool to identify mantle and crustal influences in the meteorically dominated shallow ground water. Data from a sampling campaign in the northern Upper Rhine Graben, close to Groß-Gerau, Germany, shows promising results, where elevated isotope ratios coincide with characteristic geochemical data, the fault location, and a previously known saltwater anomaly spatially defined by new geochemical data. Higher saline NaCl-dominated waters show an impact of mantle fluids revealed by ^{3}He/^{4}He isotope analysis. The ratio is highest where the main fault of the northern Upper Rhine Graben crosses the Rhine river. This suggests that the fault is hydraulically active and connects ascending deep fluids with the shallow aquifer.

UP 10.2 Thu 17:15 M/SR3

Coastal upwelling velocities inferred from helium isozope disequilibrium — Reiner Steinfeldt[1], Jürgen Sültenfuss[1], •Marcus Dengler[2], Tim Fischer[2], and Monika Rhein[1] — [1]Universität Bremen, Institut für Umweltphysik — [2]Helmholtz-Zentrum für Ozeanforschung Kiel (GEOMAR)

Oceanic upwelling velocities are too small (in the order of 10-5 m/s) to be measured directly. Here we use oceanic measurements of the helium-3/helium-4 isotopic ratio as an indirect means to infer these velocities. The water that upwells into the oceanic mixed layer from below is typically enriched in the lighter isotope helium-3. This excess of helium-3 originates from venting of primordial helium through hydrothermal activity. Helium data have been collected on four cruises within the coastal upwelling regions off Mauritania and Peru.

Near the coast, the helium derived upwelling velocities are in good agreement with the wind driven flow calculated from Ekman theory. At some locations in the open ocean, however, the helium method results in much higher vertical velocities compared to the wind derived Ekman divergence. This enhanced upwelling might be attributed to eddy activity. Both advective and turbulent (derived from microstructure measurements) fluxes of heat and nutrients into the mixed layer are determined. In coastal upwelling regions, these fluxes play a key role in fostering ocean primary productivity and cooling of sea surface temperature.

UP 10.3 Thu 17:30 M/SR3

Entgasung eines Sees, um limnische Eruptionen zu vermeiden — •Bertram Boehrer[1], Javier Sanchez-Espana[2] und Inaki Yusta[3] — [1]Helmholtz Centre for Environmental Research - UFZ, Magdeburg, Germany — [2]Geological Survey of Spain (IGME), Madrid, Spain — [3]University of the Basque Country (UPV/EHU),Bilbao, Biscay, Spain

Der Guadiana See im Erztagebau Herrerias (Andalusien, Spanien) füllte sich nach Aufgabe der Abbautätigkeit durch aufgehendes Grundwasser. Die Oxidation der anstehenden Metallerze führte zu einer extremen Versauerung der zufließenden Wässer, die dann Karbonat aus dem anstehenden Gestein lösen konnten. Es bildete sich Kohlensäure (gelöstes CO2) das sich in großen Mengen im Tiefenwasser ansammelte (2.5 Liter pro Liter Wasser). Um einem explosiven Austritt und der Gefahr des Erstickens von Menschen und Tieren in der Umgebung zuvorzukommen, sollte man das Gas kontrolliert entfernen. Zur Demonstration der Gefahr wurde - ähnlich wie in den Seen Nyos und Monoun in Kamerun - eine Röhre in den See gestellt, die Wasser nach oben führt und in einer Fontäne einen Großteil des Gases entlässt. Der Antrieb wird allein durch den Auftrieb der entstehenden Gasblasen in der Röhre bewerkstelligt. - Sánchez-España, J., Boehrer, B., Yusta, I. Environ. Sci. Technol. 48 (8), 4273 - 4281 (2014) doi: 10.1021/es5006797

Invited Talk UP 10.4 Thu 17:45 M/SR3

Können Einsteins Teeblätter das Wattenmeer vor dem Untergang retten? — •Hans Burchard — Leibniz-Institut für Ostseeforschung Warnemünde

Einstein nutzte im Jahr 1926 ein Alltagsexperiment, um die asymmetrische Erosion des Bodens eines gekrümmten Flussläufes und damit die Mäanderbildung von Flüssen anschaulich zu erläutern. Es ist die durch die Asymmetrie hervorgerufene laterale Sekundarströmung, die einen Netto-Sedimenttransport und damit morphodynamische Veränderungen bewirkt. Ähnliche Prozesse entscheiden das Schicksal des Wattenmeeres, das sich zwischen vorgelagerten Inseln und dem Festland in der Deutschen Bucht erstreckt und durch bei Niedrigwasser trockenfallenden Flächen (den Watten) chrakterisiert ist. Einem bisherigen Meeresspiegelanstieg von etwa 0.2 m / Jahrhundert konnte das Wattenmeer trotzen, indem ein Netto-Sedimentimport aus der Nordsee die Wattenflächen mit der selben Rate wie der Meeresspiegelanstieg anwachsen ließ. Im Wattenmeer wird die Querzirkulation hauptsächlich durch Dichteunterschiede zwischen den Watten und der offenen Nordsee verursacht. Im humiden Klima der mittleren Breiten sorgt ein Überschuss von Niederschlag gegenüber der Verdunstung dafür, dass das flache Wattenmeer sich stark versüßt. Nun wird allerdings für die Zukunft aufgrund des globalen Klimawandels eine Beschleunigung des Meeresspiegelantieges postuliert mit Raten von bis zu 1 m / Jahrhundert. Es stellt sich die Frage, ob die hier beschriebenen Prozesse des Netto-Sedimentimportes auch noch bei diesem erheblich erhöhten Sedimentbedarf ausreichen.

UP 10.5 Thu 18:15 M/SR3

Fingerprinting North Atlantic water masses near Iceland using Nd-isotopes — •Norbert Frank[1], Astrid Waldner[2], Paolo Montagna[3], Christophe Colin[4], and Qiong Wu[5] — [1]Institut für Umweltphysik, INF229, Heidelberg — [2]Paul Scherrer Institute, Villigen, Switzerland — [3]CNR - ISMAR, Bologna, Italy — [4]IDES, Université de Paris-Sud, Orsay, France — [5]State Key Laboratory, Tongji University, Shanghai, China

The radiogenic ^{143}Nd/^{144}Nd ratio of seawater is a valuable tracer of north Atlantic circulation pathways, driven by continental runoff (freshwater and Aeolian dust), boundary exchange and advection and thus mixing patterns. A region of particular interest in the North Atlantic is the overflow across the Iceland-Scotland Ridge injecting water from the Arctic Ocean into the Iceland basin (Iceland Scotland Overflow Water). However, Iceland itself constitutes a local source for Nd due to possible leaching of young volcanic basalts adding radiogenic ^{143}Nd/^{144}Nd to seawater. We have conducted an intense survey of physical properties and Nd-isotope composition between Iceland and the Azores that allows to fingerprint different water masses of the North Atlantic through the ^{143}Nd/^{144}Nd ratio and that demonstrates the very local influence of volcanic material to the seawater Nd cycle. A first local transect is achieved from the open ocean to the outflow of the Vatnajökull glacier. Runoff influences seawater Nd in close vicinity (<40km near the outflow). A along shelf transect provide a similar observation. From Iceland to the Azores, however, water masses of the sub-tropical and sub-polar gyre are clearly distinguishable.

UP 10.6 Thu 18:30 M/SR3

Radiocarbon reservoir variations in a stalagmite from Northern Oman during the early Holocene — •Jens Fohlmeister[1], Andrea Schröder-Ritzrau[1], Bernd Kromer[2], and Norbert Frank[1] — [1]Institute for Environmental Physics, University of Heidelberg, Heidelberg, Germany — [2]Klaus-Tschira Laboratory for Archeometry, Mannheim, Germany

Observations of the precipitation pattern in Oman during the Holocene are sparse and limited to a few lacustrine sediment records and speleothem studies. Proxies from cave carbonates from Hoti cave in Northern Oman highlight a long lasting, more humid period between ~9000 to 6000 years before present (BP). Variations in the amount of rainfall during the humid period are responsible for changes in vegetation cover. In this study we use radiocarbon measurements, performed on the carbonate of speleothem H5, to analyse the variations in the

reservoir effect. Those changes can be interpreted in terms of a modifying vegetation cover and soil organic matter dynamics above the cave. The data indicate, that prior to 8200 years BP today the region was only barely covered with living vegetation. Only dead organic matter was decomposed by microbes and was the single source for soil gas CO2. This condition changed at about 8200 years BP, where the soil became covered by plants, favoured by more humid conditions. About 100 years later, climate deteriorations led to a renewed adaption of the ecosystem with a retreat of vegetation.

UP 10.7 Thu 18:45 M/SR3

Evolution of nuclear weapon-produced tritium and its decay product He-3 in the Mediterranean Sea, 1952-2011 — •Wolfgang Roether — IUP Univ. Bremen

After 1952, tritium in the Mediterranean Sea (Med) rose 100-fold up to a 30 TU peak in 1965 (1 TU = [H-3/H] · 10^{18}) and thereafter declined to about 1 TU in 2011. This resulted in a strong supply of its stable daughter He-3, concentrated in the 1960s. Terrigenic He being low in He-3 due to a predominantly crustal origin allowed precise determination of the tritiugenic He-3 (± 0.7% in delta He-3). The highest He-3 was found off the Tyrrhenian Sea in 1983 (delta He-3 ∼ 16%). The principle input into the subsurface waters occurs in the Eastern Med by way of the Levantine Intermediate Water (LIW), which moves as a high-salinity core westward toward the Strait of Gibraltar. The observations demonstrate strong longitudinal flow dispersion. As tritium-He-3 ages are biased toward times of strong input, one finds an age increase with calendar year of observation, attributed to fast flow contributions showing up first. A realistic estimate for transfer from the LIW source up to the Western Med is 22 years. Especially in the East, He-3 lately decreased distinctly, in response to the reduced He-3 generation.