

be observed that generally limnic parts are dominant in chrome spinel which corroborates the hypothesis of a Tethys ophiolitic suture to the south of the Northern Calcareous Alps as a significant source within non-marine successions.

Preliminary results from the Palaeocene/Eocene boundary sedimentary rocks of Austria: Microflora and palaeoclimate interpretation

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This paper reports on the first microflora including coccoliths, dinoflagellates, pollen and spores from P/E-boundary strata (ca. 55 ma) in Austria. The original accumulation place was situated along the north western margin of the Tethys on a shallow southern shelf of the European Plate. This newly discovered outcrop (25 km to the north of Salzburg) today is part of the South-Helvetian thrust unit. Using the palaeogeographic reconstruction of SCOTSE & GOLONKA (1992), the palaeolatitude can be estimated as approximately 40° northern latitude. The dinoflagellate assemblages are dominated by an acme of the Upper Palaeocene taxon *Apectodinium*, which makes up 62 % of the total marine palynoflora, particularly *A. augustum*, which is thought to be typical for the P/E boundary strata. The thermal maximum at the Palaeocene/Eocene-boundary lasted ca. 170000 years (RÖHL et al. 2007), but previously investigated terrestrial plant communities (North America: HARRINGTON 2003, WING et al. 2003; Australasia: CROUCH & VISSCHER 2003; north western Europe: COLLINSON et al. 2003, 2009) did not display high quantities of typical megathermal elements as known from the Eocene megathermal event. Our new findings confirm these results: The pollen and spore assemblages are dominated by various *Normapolles* taxa, gymnosperms are extremely rare. Climate-indicating palynomorph taxa occur in small numbers only (counts from one to seven), generally below 1 %. They mostly represent warmth-loving taxa from more mesothermal conditions („subtropical“), such as, *Ilex*, *Lithocarpus*, *Trigonobalanopsis*, Hamamelidaceae, Rutaceae, Juglandaceae, Rhoipteleaceae, *Parthenocissus*, Restoniaceae and Schizaeales, whereas true megathermal („tropical“) taxa are represented by few families, only, such as Arecaceae (2), Anacardiaceae (1) Sapotaceae (2), Icacinaceae (1), Bombacaceae (1), Myristicaceae (1) and Sterculiaceae (1). In future, further localities will be explored and might shed more light on the question why the P/E atmospheric warming, had not caused a severe turnover in land vegetation.

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Human occupation of the High Himalaya range: archaeo-botanical evidence from a high alpine meadow in NW-Bhutan

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High alpine environments place severe constraints on a full-scale human occupation due to a series of geomorphologic, ecologic and physiological parameters. As a consequence high altitude landscapes like the Tibetan Plateau (e.g., BRANTINGHAM et al. 2007), the High Himalaya (e.g., MEYER et al. 2009) or the central European Alps (e.g., TINNER et al. 2007) were only permanently colonized in the course of the Holocene i.e. by Neolithic tribes with special economic and social as well as physiologic adaptations which allowed them to survive under these rather harsh climatic conditions. Nevertheless, the available archaeological and palaeoenvironmental evidence for prehistoric human activity in high altitude environments is extremely sparse partly due to the number and intensity of erosional processes, which are capable of destroying traces of former human occupancy within a short time. Here we present archaeo-botanical and paleoenvironmental data from the high alpine valleys in NW Bhutan (4000 - 4500 m asl.) which provide one of the earliest proofs of human activity yet known for the High Himalaya range.

The archaeo-botanical data were retrieved from a high al-

pine meadow in the Lunana district of the Pho valley situated at an altitude of 4100 m asl, which today is used by herders as a summer grazing for yaks. Additionally to yak herding, barley and root vegetables are grown during the summer months by the inhabitants of the permanently occupied small villages to subsist in this harsh environment. The yak pasture is located behind a lateral moraine at Thanza and is build up by minerotrophic peaty to organic rich soil with an undulating surface and covered by strongly grazed Cyperaceae. Samples were recovered by drilling a core of 74 cm length and altogether 42 samples were collected every two centimetres. In combination with three ^{14}C ages from the bottom (ca. 4280 a BP), at 26 cm depth (3255 a BP) and 18 cm depth (1980 a BP) of the core, thus a decadal to centennial resolution was achieved. All samples were examined for total organic Carbon (TOC), microscopic charcoal and palynomorphs. The TOC values decrease from 40 to 60 % at the base to below 5 % towards the top of the core, thus evidencing the reduction of peat building plants (e.g., *Kobresia*) and a decline in organic growth rate by a factor of three, whereas the last and most obvious shift occurred around 2000 a BP. Microscopic charcoal (10-35 μm) is present in more than 50 % of the samples but is particularly enriched in the upper part of the core at extrapolated ages of 1400 a BP and 1200 a BP suggesting that early settlers used fire for clearing the alpine meadows from woody growth. Isolated charcoal pieces from adjacent clastic sediments revealed even older ages (6710 a BP). The palynomorphs distribution through the core show distinct decreases in peat building taxa and local woody vegetation (e.g., *Juniperus*, *Ericaceae*, *Spiraea*) and pulsed increases of unpalatable plants (e.g., *Thalictrum*, *Anemone*, *Senecio*, *Swertia*, *Lomatogonium*) and unattainable plants for grazing livestock (e.g., *Primula*, *Draba*, *Koeningia*, *Acanthocalyx*). Contemporaneously, phases in which wild grasses not favoured by yaks (e.g., *Poa*, *Agrostis*) and mosses and ferns are very abundant do occur in the upper part of the core, the latter witness pioneering plant successions, which take place after a destruction of the vegetation cover. The most pronounced and abrupt vegetation changes are observed near the base of the core (at ca. 4700 years before present) and are interpreted as the result of human arrival and impact on the natural vegetation assemblage due to slash burning practices and yak husbandry. A semi-continuous intensification of land use by humans with few intercalated periods, in which peat building sedges and carbon accumulation could recover to some extent are observed up-section. Additionally, cereal pollen of the *Hordeum*-type (barley) and an unknown type could be extracted and analysed under SEM, thus giving evidence for early barley cultivation (i.e. since the Mid Holocene).

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Sicherheitstechnische Aspekte für die Ausrüstung von Carbon Capture and Storage (CCS) Bohrlöchern

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Um die Integrität von CCS Bohrlöchern für die Dauer der Injektion aber auch für die Periode nach Abschluss der Injektionsphase sicher zu stellen, sind Maßnahmen erforderlich, die über jene bei der konventionellen Förderung und Speicherung von Kohlenwasserstoffen hinausgehen. Bei der Umkomplettierung eines bestehenden Bohrloches, welches der Gewinnung oder Speicherung von Kohlenwasserstoffen diene ist zu berücksichtigen, dass die ausgewählten Materialien für die Futterrohrkolonnen nicht notwendiger Weise CO_2 beständig sind. Bei der Komplettierung von neuen Bohrungen kann die erforderliche Medienbeständigkeit in der Planungsphase Berücksichtigung finden. Grundsätzlich sind für CO_2 Injektionsbohrungen Open Hole Komplettierungen oder Cased Hole Komplettierungen denkbar.

Um den Anforderung hinsichtlich Gesundheit/Sicherheit und Umweltschutz zu genügen sind Maßnahmen zu ergreifen, die über das konventionelle Maß der Beobachtung von Sonden bei der Kohlenwasserstoffproduktion hinausgehen. Diese Schritte sind insofern von Nöten, zumal mit diesen Maßnahmen den speziellen Anforderungen durch das CO_2 aus chemischer und physikalischer Sicht genügt wird. In diesem Zusammenhang ist zu berücksichtigen, dass es sich bei CO_2 um ein farb- und geruchsloses Gas handelt, welches schwerer ist als Luft und bei entsprechender Konzentration tödlich sein kann.

Bei Arbeiten zur Umkomplettierung eines Bohrloches sind die besonderen physikalischen Eigenschaften von CO_2 zu berücksichtigen und damit Schritte zu tätigen die sich von konventionellen Behandlungsarbeiten bei KW Sonden unterscheiden. Vor Inangriffnahme derartiger Arbeiten sind daher ganz wesentliche Schritte zu tätigen.

Im Folgenden wird davon ausgegangen, dass für die Injektionsarbeiten eine behördliche Genehmigung vorliegt. Die CO_2 Injektion dient nicht zur verbesserten Entölung einer Lagerstätte (Enhanced Oil Recovery) sondern zur Verbringung von CO_2 in den Untergrund.

Unterbechungskriterien/Abbruchkriterien definieren jene Randbedingungen, bei deren Nicht - Erreichen eine vorübergehende oder permanente Unterbrechung des Injektionsprozesses solange erforderlich ist, bis die Mängel beseitigt sind und der sichere Injektionsvorgang wieder aufgenommen werden kann.

Petrology of the silicate/ore contact zone of the Pb-Zn deposit Pflersch/Schneeberg (South-Tyrol, Italy)

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