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Preliminary observations of the magmatic mineralogy of Pliocene volcanics from Alchar, Macedonia: significance for the mineralization process

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The formation of porphyry and epithermal ore deposits requires a number of agents including chlorine as main ligand for transporting metals in hydrothermal systems (e.g., Heinrich 2005). Here, we investigate the compositions of magmatic and hydrothermal minerals of the volcanic-hosted hydrothermal ore system of Alchar, Macedonia as no mineral chemistry of was reported from the Alchar volcanic complex. Alchar is a calcalkaline intrusive and extrusive complex also extending to northern Greece (Yanev et al. 2008), which hosts an epithermal Au-As-Sb-Tl deposit (Kochneva et al. 2006). The volcanic products including the cooling history of a subvolcanic latite body of Alshar (Alshar latite in the further text) were recently dated by $^{40}Ar/^{39}Ar$ mineral dating and the ages range from 5.1 Ma (age of intrusion) to 3.3 Ma (age of cooling through ca. 200°C; Neubauer et al. 2009). The biotite ages of 5.0± 0.1 and 5.1±0.1 Ma from blocks of the Vitacovo tuff forming likely the initial Pliocene volcanism in the Alchar region indicating that Alchar latite and the Vitacovo tuff formed at the same time by the same process. A hydrothermal K-feldspar of Alshar precisely dates the main event of subsequent hydrothermal alteration at 4.31±0.02 Ma.

Our investigations of amphibole and biotite of subvolcanic latite from Alchar and of the Vitacovo tuff show a significant compositional variation of magmatic minerals. Phenocrystic amphiboles of the Vitacovo tuff exhibit a significant zoning. The cores are commonly magnesio-hornblende, rims magnesio-hastingsite. Clinopyroxene phenocrysts are also commonly zoned and their compositions vary within the diopside field. The chlorine contents of amphiboles and phlogopite are between 0.02 and 0.1 wt%. Some amphiboles, clinopyroxenes and plagioclases reveal an oscillatory zoning and the variation of plagioclase is between $Ab_{42.5}An_{55.4}Or_{2.2}$ and $Ab_{63.6}An_{30.8}Or_{5.6}$. Oscillatory zoning of amphibole, plagioclase and clinopyroxene response either to P-T fluctuations during crystallization (Garcia-Casco et al. 2002) or can be related to mixing events in magma chambers. Magmatic processes such as crystallization recharge in magma chambers, decompression during ascent and convection can explain these patterns (Ginibre et al. 2007).

The phenocrystic amphibole is uncommon in the Alshar latite. Diopside is again slightly zoned. Plagioclase is less zoned than in the about coeval Vitacovo tuff and compositions range between $Ab_{57.1}An_{37.4}Or_{5.6}$ and $Ab_{48.6}An_{48.7}Or_{2.7}$. The chlorine content in rare amphibole and abundant phlogopite ranges between 0.08 and 0.18 and is similar to that of same minerals of the Vitacovo tuff.

Our new mineral data suggest that chlorine as a major agent for ore formation originates from the magmatic system and was likely released from the magma. Fluid inclusions of the epithermal ore system indicate a low-salinity hydrothermal fluid for mineralization (Kochneva et al. 2005). The above mentioned dated K-feldspar is relatively rich in the albite component (27.6 to 29.0 mol percent), low in the An component and shows BaO contents of 0.76 and 2.30 wt%. The high albite content seems uncommon for hydrothermal alkali feldspars.

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Artiodactyl trackways in Pleistocene eolianites on Antiparos (Central Cyclades, Greece)

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Yellowish calcarenite sandstones have been mapped along the NW coast of Antiparos island (Aegean). These sandstones form dm to 5 m thick layers which cover greenschist to amphibolite grade metamorphic rocks of the Attic-Cycladic Crystalline of the Central Hellenides. The sandstones can be traced from below sea-level up to an elevation of approximately 80 m. Generally, the sandstone layers and the internal lamination are parallel to the slopes of the underlying crystalline without forming any morphological terraces; cross-bedding with dip-angles >35° has only rarely been recorded. The sandstones are dominated by marine bioclasts including mainly corallinaceaen red algae, benthic foraminifers and fragments of gastropods and bivalves with siliciclastic components of less than 20 %. The sandstones are

cemented by calcite; the grains are well-rounded and well-sorted with grain sizes ranging from medium sand to granule sizes. Based on the areal distribution of the sedimentary structures (e.g., pin stripe lamination, high angle cross bedding), the occurrence of terrestrial gastropod shells and the correlation with almost identical sandstones in the Mediterranean we conclude an eolian origin and a most likely Pleistocene age of these sandstones.
Several vertebrate tracks and trackways have been found in these sandstones. To our best knowledge, this is the first report of vertebrate trackways in Pleistocene sandstones of the Aegean. However, comparable trackways, both in age and size, have been reported on the islands of Mallorca and Sardinia (Fornos et al. 2002, Fanelli et al. 2007). Tracks have been found on bedding surfaces and in cross-section, where tracks are concentrated along certain horizons; the tracks are about 11 cm wide and 4 cm deep. On bedding surfaces at least two distinguishable trackways are recorded. Due to overlapping tracks and weathering, the differentiation between manus and pes impressions is challenging. This, and the relatively short length of individual trackways - the longest traceable trackway is only about 1.50 m long - make stride and pace measurements difficult. The track morphologies (e.g., preservation of a cloven hoof track) and trackway sizes indicate an artiodactylous mammal with the size of a goat, deer or antelope or a comparable sized animal as trackway producer, whereas goats per se are not likely to be the originator of the tracks, as goats were introduced to the Aegean islands by man. It is most likely that the tracks were made by fallow deer, whose remains were also found during the archaeozoological rescue excavation in the Antiparos Cave (Psathi 2006). Also, if we expect the sea level to be approx. 125 meters below the modern day mean sea level during the last glacial maximum in the late Pleistocene (Yokoyama et al. 2000), various land bridges would have developed (Kapismalis 2009) allowing faunal interchange with other Cycladic islands.

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Reconstruction of the autochthonous Upper Eocene depositional environment in the Bad Hall area (Upper Austria)

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Sandstones of the Upper Eocene are the main oil bearing strata within RAG's Upper Austrian concession area. Knowledge of their lateral extent and vertical stacking pattern is of crucial interest for a successful expoloration and production strategy. Facies distribution maps in a regional scale have been provided by L. Wagner in 1980. Recent drilling activities revealed the necessity to elucidate the depositional environment and its extent in the Bad Hall area.
The herein proposed study is integrative in scale and disciplines. The main idea behind is the concept of „Dynamic Stratigraphy“. Examined key cores reveal facies associations, which are interpreted as river-dominated delta. An interpretation of the lateral extent and geometry of the Upper Eocene depositional environment is aided by seismic characterization, using ThinMAN™ broadband spectral inversion. Moreover the sedimentological analysis is supported by a detailed micro-paleontological (palynomophs and foraminifera) and petrographical study.

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Multi-Offset Ground Penetrating Radar (GPR) Investigations of a Snow Pack

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The water equivalent of a snow pack is a crucial information regarding hydrological and glaciological studies. The classic way to gain this information are direct, manual snow density measurements in a snow pit. In the case of a several meters thick snow cover, digging a snow pit is time consuming, extensive work. Caused by enhanced surface melting during summertime, most often a continuous, thick top ice cover evolves in the accumulation area of a glacier. In autumn, when the final field survey for the determination of the annual mass balance is held, this top ice cover represents a hard to penetrate layer. Most often snow density information is only measured for the autumn snow until the summer surface layer, because gathering deeper density information would demand an unreasonable, disproportional amount of work. Snow densities below the summer surface layer are estimated by a best guess.