Radiometric ^{81}Kr dating reveals 120,000 year old ice at Taylor Glacier, Antarctica

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Ancient ice can not only be obtained from deep ice cores, but also at ice sheet margins and blue ice areas (BIAs) where it outcrops due to local ice dynamics and surface ablation [1]. Determining an accurate chronology for BIA records is more challenging than for regular ice cores. Here we report the first successful ^{81}Kr radiometric dating of ancient BIA ice. ^{81}Kr ($t_{1/2}$ = 229 ka) is produced cosmogenically in the upper atmosphere, and the modern ^{81}Kr-Kr ratio is used as the reference. Krypton is not reactive and is well mixed in the atmosphere. In principle ^{81}Kr dating can be used to date ice in the 50ka to 1Ma age range; it is widely applicable as all glacial ice contains trapped air; it does not require a continuous or undisturbed ice stratigraphy; and it does not suffer from *in situ* cosmogenic production in the ice (as is the case for ^{14}C). The large sample size requirement (> 40 kg) has precluded its use in ice core science to date.

Air was extracted on site from four 250 kg polar ice samples obtained from 5-15m below the surface of Taylor Glacier, McMurdo Dry Valleys, Antarctica. Krypton was separated from the air and dated using Atom Trap Trace Analysis [2]. The ^{81}Kr radiometric ages agree with independent stratigraphic dating techniques within 6ka. ^{85}Kr analysis shows that the samples are free of modern air contamination, validating our sampling strategy and experimental methods. We show that ice from the Eemian interglacial (130-120ka BP) can be found in abundance near the surface of Taylor Glacier. Our study paves the way for reliable radiometric dating of ancient ice in BIAs and margin sites, greatly enhancing their scientific value as archives of old ice and meteorites. As sample size requirements continue to decrease, ice core ^{81}Kr dating might be a future possibility.

[1] Bintanja (1999) Rev. Geophys. **37** 337-359. [2] Jiang *et al.* (2012) Geochim. Cosmochim. Ac. **91** 1-6.

Geochemical types of tantalum and niobium mineralization from the rare metal-bearing granites and pegmatites of the Western Mongolia

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Tantalum-niobates are typical representatives of the rare metal mineralization in Middle Paleozoic and Early Mesozoic pegmatites and amazonite granites of the Western Mongolia (the Mongol Altay, the Charchirinsk upland region). They are seen in association with beryl in pegmatites, and characterized by heterogeneous composition of minerals, which is displayed in variability of Ta/Nb ratio from 0,3 to 3,0 from the grain core to boundaries. Tantalum-niobates in granites have microscopic sizes (2,5-150 μm) and are present as poikilitic inclusions in rock-forming minerals of protolitionite-microcline-albite paragenesis, more rarely in accessory fluorite and magnetite. At the same time, tantalum niobite grains are chemically homogeneous, but differ from each other by various Ta/Nb (0,03-0,4) and Ti/Nb (0,02-9,8) ratio, as well as significant content of LREE (20 wt.%), Sn (up to 4 wt.%). Ilmenorutile (Ta+Nb from 3-12 to 23-27 wt. %), columbite-(Mn), columbite-(Fe), tantalite-betafite, betafite, and polycrase were defined in the rocks studied. These elements show acid-base conditions for mineral-forming environment. Changing alkalinity during pegmatite crystallization is noted within some zonal minerals as transforming of columbite into ilmenorutile (Ta/Nb-1,3; Ti/Nb-3,1), and tantalite-betafite (Ta/Nb 2,5 до 3,0; Ti/Nb-0,5). Iron content coefficient (FeO/MnO) varies significantly (non-manganese up to 8,6), at the same time late non-manganese varieties are often enriched in REE, U, or Y. Despite the similar patterns of chemical evolution defined for granitoid melts, the differences in U, Pb, Y, F, W, Sn, LREE, Th contents observed in tantalum-niobates of pegmatite and amazonite granites indicate heterogeneous crust magma sources and their intrusion under different paleogeodynamic conditions.

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