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**VOLCANIC ASH LAYERS IN BLUE ICE FIELDS (BEARDMORE GLACIER AREA, ANTARCTICA): IRIDIUM ENRICHMENTS.** Christian Koeberl, Institute of Geochemistry, University of Vienna, A-1010 Vienna, Austria; and: Lunar and Planetary Institute, 3303 NASA Road One, Houston, Texas 77058, USA.

**Introduction.** Dust bands on blue ice fields in Antarctica have been studied by several autors (e.g., 1-3) and have been identified to originate from two main sources: bedrock debris scraped up from the ground by the glacial movement (these bands are found predominantly at fractures and shear zones in the ice near moraines), and volcanic debris deposited on and incorporated in the ice by large-scale eruptions of Antarctic (or sub-Antarctic) volcanoes. Ice core studies have revealed that most of the dust layers in the ice cores are volcanic (tephra) deposits (e.g., 4, 5) which may be related to some specific volcanic eruptions. These eruptions have to be relatively recent (a few thousand years old) since ice cores usually incorporate younger ice. In contrast, dust bands on bare blue ice fields are much older, up to a few hundred thousand years, which may be inferred from the rather high terrestrial age of meteorites found on the ice (e.g., 6) and from dating the ice using the uranium series method (7, 8).
Also for the volcanic ash layers found on blue ice fields correlations between some specific volcanoes (late Cenozoic) and the volcanic debris have been inferred, mainly using chemical arguments (1, 3). In some cases the proposed source volcanoes are at distances of several thousand kilometers from the sites of the dust bands (e.g., South Sandwich Islands to Yamato Mountains Meteorite Field, about 3000 km; Melbourne Volcanic Province, Northern Victoria Land to Lewis Cliff, Beardmore Glacier, about 1500 km). The size of the debris is a function of the distance from the source volcano (9), which means that the size of the volcanic debris gets small the further away from the eruption it is deposited. The settling of the debris is also influenced by wind effects. Several volcanoes, which are thought to be sources of debris found in the interior of the Antarctic continent are on the rim of the continent. The unique Antarctic wind pattern of the katabatic winds, which blow almost contantly from the South to the shore (without changing wind direction or speed over a long time) thus requires volcanic debris to travel either against the wind, or to be injected into the stratosphere to enter the wind system (3). Larger grains or volcanic shards settle out quite fast, leading to the deposition of very small shards. The average grain size of volcanic debris in the Allan Hills Ice Field, which most probably has originated from sources at the nearby McMurdo volcanic province, is close to 100 µm, while the average grain size at the Yamato Mountains (possible source at the South Sandwich Islands) is much smaller (1).

**Dust bands at the Lewis Cliff blue ice fields.** During a recent field expedition (mainly for meteorite collection; 10) samples of several dust bands found on blue ice fields at the Lewis Cliff Ice Tongue (Walcott Névé, Beardmore Glacier Area; Antarctica) were taken. These dust band samples have been divided for age determination using the uranium series method, and chemical investigations to determine the source and origin of the dust bands. The samples from the chemical studies were processed in the field, and only the dust component was isolated and taken out of Antarctica (3). The investigations have shown that most of the dust bands found at the Ice Tongue (distant from moraines) are of volcanic origin and, for chemical and petrological reasons, may be correlated with Cenozoic volcanoes in the Melbourne vol-

canic province, Northern Victoria Land, which is at least 1500 km away (3). There are no volcanic centers (that have been active at the required time, probably 100000-200000 years ago) nearby, so the ash deposited here has travelled a larger distance, almost directly south (i.e., agains the direction of the katabatics) from the eruption site. This is also reflected in the average grain size of the volcanic debris, which is between 10 and 40 µm. Thus the Lewis Cliff volcanic glass shards have a smaller average grain size than the debris at most other sites investigated so far.
Major and trace element data have been obtained and have been used for identification and correlation purposes (3). Recently, some additional trace elements have been determined in some of the dust band samples, including Ir. Iridium determinations have been made using INAA, with synthetical and natural (meteorite) standards. Preparation of the dust band samples was performed in a contamination-free environment using a clean-bench, so any laboratory contamination can be excluded. The rather unexpected result was that most dust band samples were found to contain Ir at measurable quantities. Iridium contents ranged between <0.5 up to 7.3 ppb in different dust band samples. No Ir was detected in non-volcanic dust bands.

**Discussion.** The rather high Ir content of the volcanic dust in the Lewis Cliff dust band samples is surprising, and seems to be an important result. Several other trace elements have been determined in the same samples. Au/Ir ratios range between 3.5 and 10 (or larger) and are thus non-chondritic. A positive correlation is evident between Ir and Se (with Se contents between 10 and 20 ppm), and enrichments are present for As, Sb, and other volcanogenic elements.
Iridium has been discovered in emmissions and aerosols from the Kilauea volcano in Hawaii (11, 12), but so far no direct correlation with Ir enrichments in volcanic deposits was known. The Antarctic environment is known to preserve terrestrial and extraterrestrial material very well for long time periods, so no other external influences or contaminations are of great importance. The small average grain size of the volcanic debris found at the Lewis Cliff site may lead to the enrichment of surface correlated elements, thus it seems likely that the Ir (and Se) was introduced from a gas phase or an aerosol source in association with fine volcanic dust. Larger average grain sizes may not show a similar Ir enrichment.
Iridium enrichments, together with high (and positively correlated) Se, Sb, and As abundances are known from K/T boundary samples, which is similar to what we observe in the Lewis Cliff dust band samples. Certainly the discovery of an enrichment in Ir in volcanic deposits may be of importance for the interpretation of the K/T boundary event. It is not to purpose of this contribution to make a strong case supporting the volcanic interpretation of the K/T event, since there are a number of good arguments in favor of an impact origin, but to caution the overenthusiastic supporters of impact: most probably the K/T event is much more complicated to explain than it may seem.

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