GEOCHEMISTRY OF VENUS CRUST AS REVEALED BY THE VENERA-VEGA ANALYSES.

A. T. Basilevsky and A. M. Abdrakhimov, Vernadsky Institute of Geochemistry and Analytical Chemistry, RAS, Kosygin Str., 19, 119991, Moscow, Russia atbas@geokhi.ru; albert@geokhi.ru.

Introduction: Surface of Venus is dominated with volcanic landforms indicative of basaltic volcanism [e.g., 1]. This interpretation is supportted by the direct Venera-Vega measurements in 7 sites: the GRS analyses of K, U, and Th (5 sites) and the XRFS analyses of Si, Ti, Al, Fe, Mn, Ca, K, S and Cl (3 sites) [2]. We consider these results comparing them with the appropriate compositional data for the Earth, the Moon, Mars and meteorites as it was done by [3]. Since that early study, new approach for comparisons with the Earth data was developed: only water-unaltered terrestrial samples are considered [4-6] and new data on Mars, the Moon and meteorites were acquired [e.g., 7, 8]. Although the analyzed Venusian materials represent the uppermost surface layer affected by the atmosphere-surface interactions, theoretical considerations show that in this process all mentioned above elements are inert [9] so we can make unbiased comparisons with magmatic rocks of other bodies.

K, U and Th: Because for Mars Odyssey GRS measurements only K and Th contents are now available [7], emphasis here is on the K-Th systematics. Figure 1 is a K-Th plot representing the Venera-Vega data on the background of a number of planetary and meteorite data [4-8]. The figure shows overlapping fields and similar trends for Earth, Mars and Venus. Lunar and HED achondrites (Vesta?) compositions show distinct depletion in volatile potassium. The Venusian compositions (Venera 8, 9, 10, Vega 1, 2) are geochemically evolved sharing levels of K, U and Th contents with Earth' island arc and hot spot rocks (even with hot spot alkaline rocks – Venera 8) [10].

Petrogenic elements. For them, trends of the equilibrium crystallization of magmas with the Venera 13, 14 and Vega 2 compositions were calculated and plotted on the composition fields of the Earth oceanic crust rocks (Figure 2). The trends were calculated using the KOMAGMAT program [11]. It is seen from Figure 2 that Venera 13 trends fit compositions typical of hot spots alkalines (like Venera 8 in K-U-Th systematics). The Vega 2 trends fit compositions typical of the island arc tholeiites and the Venera 14 trends fit compositions typical of MORBs [10].

Discussion and conclusions: Similarity of K-Th trends for Earth, Mars and Venus composition fields suggests compositional similarities in these planets' accreting materials and similarities in these planets' melting-crystallization processes. The SNC data are mostly inside the MORB compositional field. MORB's geochemistry is a signature of the depleted source. But in the case of SNC meteorites it is obviously because most of them are pyroxene/olivine cumulates. Mars Odyssey GRS data are geochemically more evolved, entering the Earth' island arc and hot spot domains [10]. This could be because they essentially represent rich in incompatible elements cotectic/eutectic lavas and regolith derived from them). The GRS field is rather narrow that is probably a combined effect of eolian lateral mixing of regolith material and large GRS footprint. Lunar and Vesta (HEDs) compositions show distinct depletion in volatile K, the feature earlier recognized as being due to these bodies' hot accretion or reacretion [12, 13, 14, 15].

As it was said above, most of the Venera-Vega materials show similarities with geochemically evolved terrestrial rocks of island arc and hot spot associassions and one (Venera 14) material shows similarity with MORB rocks [10]. Similarities with MORB, island arc and hot spot rocks do not implie that Venus has or had elements of plate tectonics or terrestrial type hot spots in its geodynamic machine. It is just signatures of depleted (Venera 14) or undepleted (all others) sources. Predomionance of undepleted sources could be a consequence of the mantle overturn [16], which, if happened, brought undepleted material of deeper mantle to the magma-generation region.

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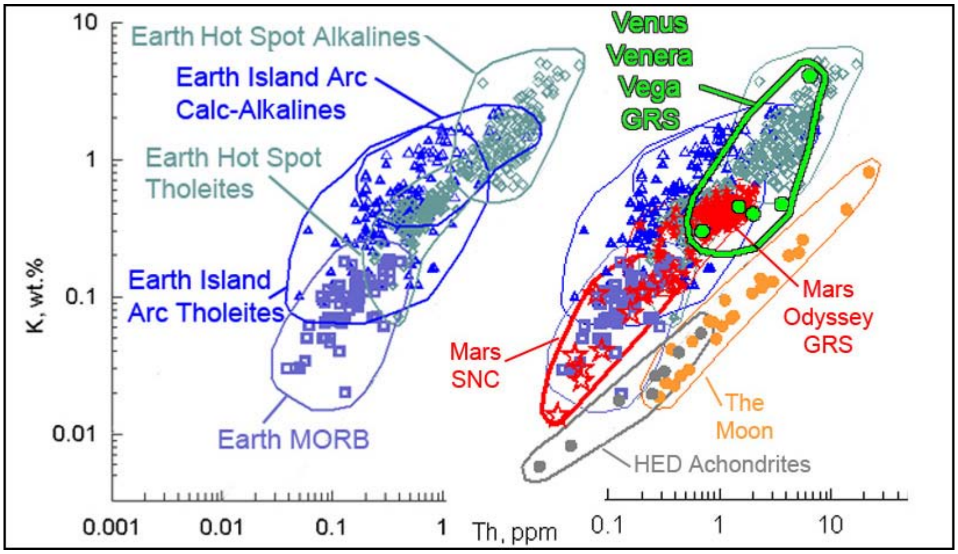

Figure 1

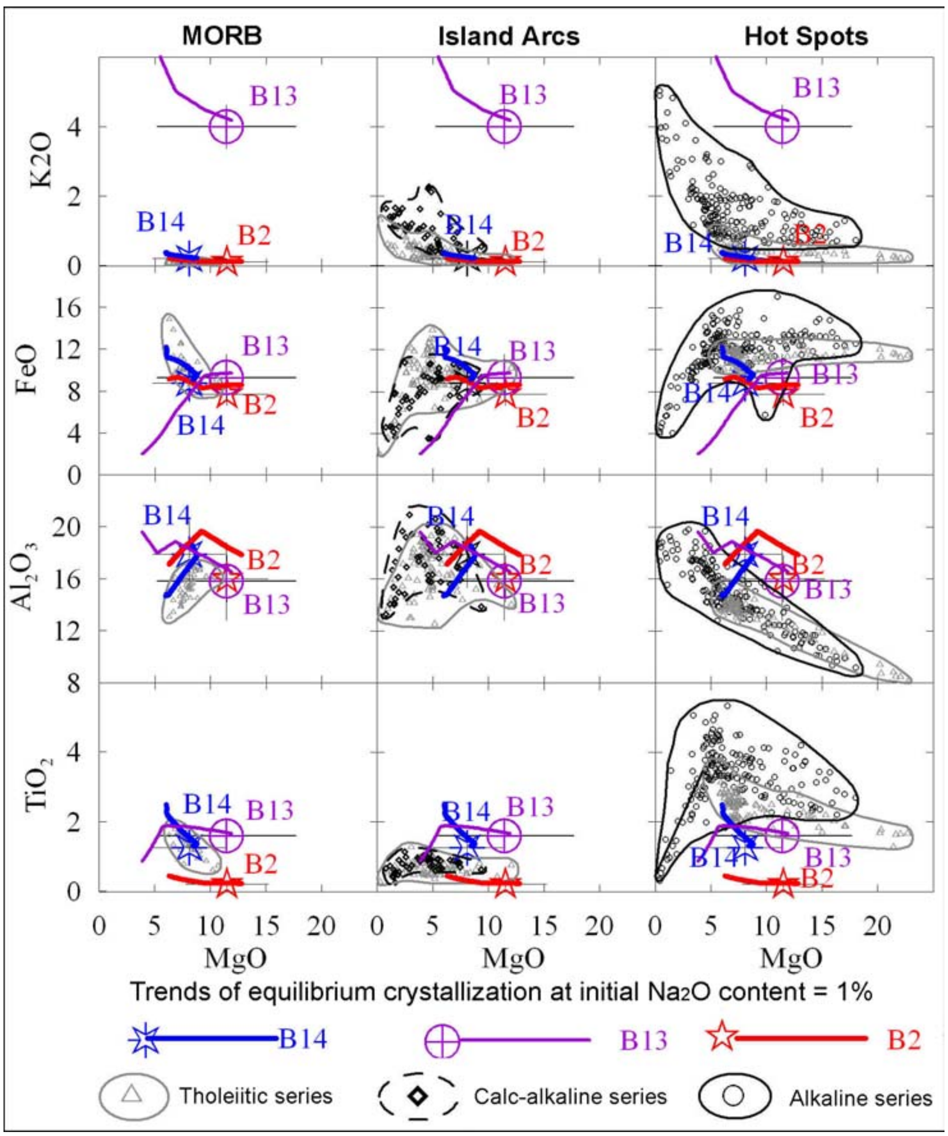

Figure 2