STRATOSPHERIC BALLOON TEST OF AERIAL ELECTROMAGNETIC PROBING OF THE LITHOSPHERE OF VENUS. R.E. Grimm, Southwest Research Institute, 1050 Walnut St. #300, Boulder, CO 80302 (grimm@boulder.swri.edu).

Introduction. Electromagnetic (EM) sounding uses induction from natural sources to build profiles of electrical conductivity of planetary interiors, which in turn can be translated to temperature and composition. Recently developed theory indicates that measurements of transverse electromagnetic (TEM) waves—in particular, lightning-caused global Schumann resonances—at any altitude in the ground-ionosphere waveguide contain information on the resistivity structure of the boundaries [1]. In other words, aerial measurements in this bandwidth can be used to probe the subsurface. This technique can measure geothermal gradient and hence lithospheric thickness (Fig. 1) from a nominal 55-km balloon float altitude, and thus make a fundamental contribution to understanding the geodynamics and interior structure of Venus without ever touching the surface. I will report on a demonstration from a stratospheric balloon.

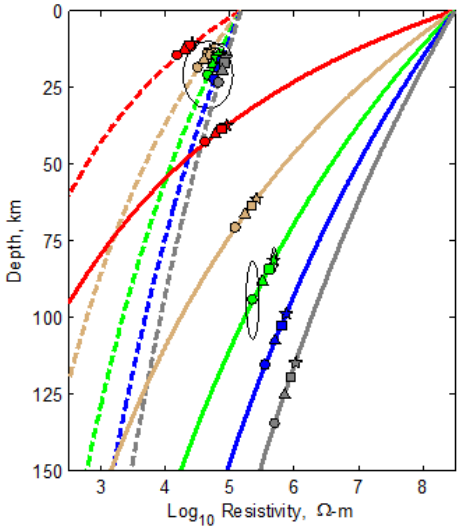

Fig. 1. Discrimination of different geothermal gradients on Venus (colored lines) using Schumann resonances (symbols) for "dry" (solid) vs "wet" (dashed) interiors [1].

Balloon Transverse Electromagntic Measurement (BTEM). A demonstration payload (Figs. 2, 3) measuring AC electric and magnetic fields is scheduled to fly at 30 km altitude over the Idaho's Salmon River Mountains in October, 2017. This location was chosen for extensive resistive crystalline rocks that are the best terrestrial analog to Venus: although resistivities are expected to be much lower than Venus, and penetration depths much less, the experiment can still achieve the following objectives (1) demonstrate that Schumann resonances can be characterized in the stratosphere. (2) demonstrate that electric fields follow lossy waveguide theory. (3) determine simultaneously the frequency dependent electrical conductivities of the ground and ionosphere. (4) determine the requirements to advance to TRL 6 for Venus flight.

Fig. 2. BTEM outdoor ground test near Boulder. Electric fields are measured between boom-tip electrodes; magnetometers are inside booms.

Fig. 3. BTEM (above cones) rigging test beneath balloon avionics package (near ceiling) at World View high bay. Separation mitigates potential interference from continuously operating radio systems.

References: Grimm R.E. et al. (2014) Icarus, 217, 462.

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