EXPLORING VENUS INTERIOR STRUCTURE BY DETECTION OF INFRASONIC WAVES. D. Mimoun[1], J Cutts[2] , D. Stevenson[3] , R. Garcia[1] and the KISS Venus workshop team, [1]Institut Supérieur de l'Aéronautique et de l'Espace (ISAE) 10 Avenue Edouard Belin BP 54032 31055 TOULOUSE CEDEX 4, mimoun@isae.fr , [2]Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, U.S.A, [3] California Institute of Technology, Pasadena, California, U.S.A

Introduction: Knowledge of the formation, evolution and structure of the terrestrial planets (including Earth) is currently impeded by the very limited understanding of the interior structure of Venus. Seismology is a powerful technique that is responsible for much of what we know about the interior of the Earth and Moon; seismology can also play a key role in answering fundamental questions about our twin planet: Venus lacks plate tectonics, which is the main source of seismic energy on Earth. However, significant seismic activity can arise when there is distributed lithospheric deformation, just as it does with intraplate tectonics on Earth. The challenge is to devise methods to determine the level of current seismic activity and constrain the global structure that would work in the severe environment of Venus. The conventional approach requires at least one terrestrial years of data on the surface, and therefore a long-lived station, solidly coupled with the ground and protected of the environment by a wind and thermal shield [5]. Such a setup is very difficult to imagine on Venus, because of the extremepressure and temperature. at the surface . Therefore, other indirect measurements should be considered. In June 2014, the Keck Institute for Space Studies (KISS) at the California Institute of Technology sponsored a one week workshop with 30 specialists in the key techniques and technologies relevant to investigating Venus's interior structure.

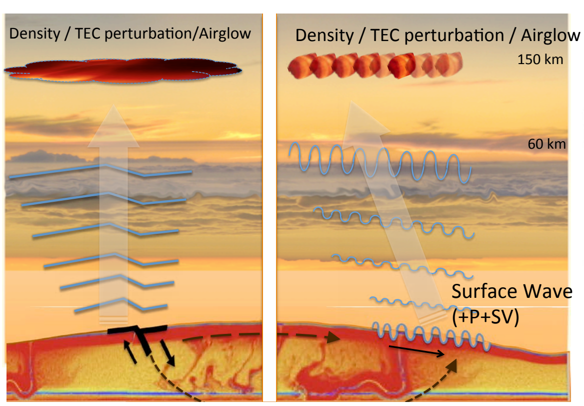

Fig 1 : Conceptual propagation of seismic waves in the venus atmosphere

Solid Venus / Atmosphere coupling: The coupling between the solid planet and of the atmosphere (e.g. Lognonné [3] makes it possible to remotely detect quakes by measurements made in, or at the top of the atmosphere. In the case of Venus, Garcia [1] has demonstrated that the perturbations in the atmosphere caused by the quakes could be detected from space. However, at some frequencies important to seismic detection atmospheric absorption will decrease the signal to noise ratio (Fig 1). Observations of infrasonic (pressure) waves *in situ* in the cloud layer, at about 60-70 km altitude would be feasible at higher frequencies.

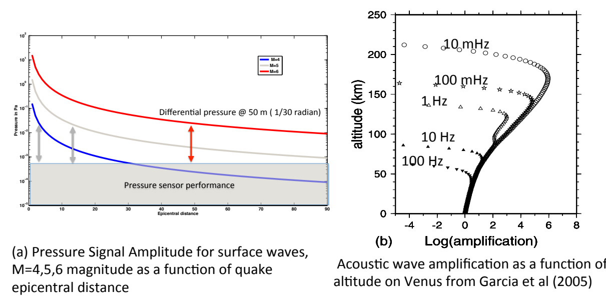

Fig 2a) : Pressure signal can be remotely monitored with a micro-barometer for M=6 earthquakes (b) Logarithm of the acoustic wave amplification factor as a function of altitude (in km) in the atmosphere of Venus assuming a vertical propagation of acoustic waves. Plots are given for different frequencies: 10 mHz, 100 mHz (, 1 Hz (10 Hz and 100 Hz from [1])

Measurement concept:

The measurement concept requires the balloon deployment of sensitive barometers, to detect the infrasonic waves. A vertical string of sensors, each sensitive in the 0.1 Hz, 1 Hz frequency range, would be used to discriminate seismic events from infrasonic events originating in the atmosphere. As in the MERMAID concept, [4], event detection could be performed on the signal to reduce the required data bandwidth.

References

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