depth. A shallow and regular lens-like magma chamber was more probable in the case of the smaller caldera. Its roof suffered a piston-like collapse into the magma chamber caused by an sill-like offspring above the level of the original main magma chamber. If some of the caldera diameter can be accounted for by subcollapses, a range of 8-10 km for the roof depth value can be estimated. If the share of subcollapses has been underestimated the magma chamber depth may have been as small as 6 km.
The two calderas of Syrtis Major Planum have diameters of about 75 km (Nili Patera) and 50 km (Meroe Patera). They are 100 km apart from each other and have distinct rims or levées. Nili Patera is a horseshoe-shaped arc. The low, dome-like elevated centre may have been caused by a laccolithic or sill intrusion. Meroe Patera is more circular with an inward-dipping wall. The preliminary estimation is 15 km for the maximum caldera roof thickness of Nili Patera. The actual magma chamber roof depth could have been slightly less. The magma chamber roof depth estimation for Meroe Patera is 8-10 km.

11.04 Dark Materials in Valles Marineris: Indications of the style of Volcanism and Magmatism on Mars

Paul E. Geissler, Robert B. Singer (Lunar and Planetary Laboratory, University of Arizona) and Baerbel K. Lucchitta (U.S. Geological Survey, Flagstaff, Arizona)

Dark, relatively gray materials are believed to be among the least altered of martian crustal components. Dark materials in Valles Marineris are observed to occur in a variety of geologic settings, including in-situ wall-rock layers exposed during the formation of the canyon system, canyon floor covering deposits such as eolian dunes, and volcanic materials, possibly indicating relatively recent volcanism in the Valles (Lucchitta, Science 237, 535, 1987). Using Viking Orbiter apoapsis color images, we have studied the spectral reflectance and spatial distribution of these materials in an attempt to understand their relation to past episodes of volcanism, tectonism, igneous intrusion, and eolian redistribution in the canyon system.

A thick, regionally extensive deposit observed in outcrops in Juventae Chasma and in a wallrock layer in Coprates is interpreted to be composed of mafic glass on the basis of spectral reflectance, erosional morphology and tendency for eolian mobilization. Multispectral mapping suggests that the eolian floor-covering materials in the lower canyons are derived from this unit. The interpretation of this unit as volcanic ash requires that the deposits were produced in pyroclastic eruptions at what was once the surface of the planet, and later buried by almost 3 kilometers of plains materials including the 400 to 600 meters of Hesperian lavas believed to resurface the Lunae-Sinai Planum region. The deposits in Coprates and Juventae Chasmata are thus probably among the oldest of martian volcanic materials. Voluminous regional deposits of mafic ash have no terrestrial analogue, although they are common on the Moon; identification of such a deposit in Valles Marineris may have important implications for the style of past volcanism on Mars.

A series of cliffs in the Ophir Chasma wallrock is interpreted to be exposures of resistant bedrock; the spectral signature of this massive and uniform unit most closely resembles that of terrestrial mafic rocks altered to or coated by crystalline hematite. Application of computer mapping techniques to probable young volcanic materials in the Central Troughs yields an inferred distribution of volcanic activity consistent with an interpretation of extrusion along faults near the margins of the canyon floors. This result supports the hypothesis (Carr, J.G.R. 79, 3943, 1974) that the Valles originated through tectonic extension.

11.05 Origin of Xe fractionation on Earth and Mars

K. Zahnle and J. B. Pollack (NASA/Ames) and J. F. Kasting (Penn State)

Terrestrial Xe is isotopically much heavier than are other solar system Xe inventories, fractionated by ~4% per AMU. The detection of probable martian atmospheric gases trapped in the SNC meteorites has revealed a second solar system noble gas inventory that has Xe and Kr abundance patterns similar to Earth, and dissimilar to solar or meteoritic inventories. These similarities between Earth and Mars seem to imply a common source; moreover, one that cannot be identified among solar system materials presently extant. Hydrodynamic escape operating *in situ* on both Mars and Earth would be unlikely to generate basically similar isotopic patterns when operating on two such dissimilar planets.

Fractionation taking place in planetesimals can provide a common source of fractionated Xe to Earth and Mars. Ozima and Nakazawa* suggested that noble gases were gravitationally concentrated in the interiors of porous planetesimals from ambient nebular gases. We supplement their argument by noting that there is a maximum pressure that a porous material can sustain and yet remain porous. As the planetesimal grew, gravitationally fractionated noble gases were trapped as pores became isolated. Thus there is a natural fractionation predicted by this model. This degree of fractionation is essentially identical to the fractionation of the xenon isotopes on Earth and Mars with respect to the nebular source. Owing to Xe's higher mass and adsorptivity, the fractionated Xe is accompanied by insignificant amounts of the other noble gases. We therefore conclude that gravitational fractionation of solar nebular xenon inside an early generation of planetesimals is the primary source of terrestrial and martian xenon. We infer that large $\geq$1000 km planetesimals accreted in the presence of the nebula in the feeding zone of the terrestrial planets.

* Ozima and Nakazawa, *Nature 284*, 313, 1980.

Session 12: Saturn
(Moderator TBA)
3:30–5:00, Grand Ballroom

12.01 Preliminary Results from the Occultation of 28 Sgr by the Saturn System: Saturn

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We will present a comparison of data on the occultation of the same star by two planetary atmospheres, Saturn's and Titan's. Details of the Titan observations will be reported by Reitsema *et al.*
Observations of the 3 July 1989 UT occultation of 28 Sgr by Saturn and its ring system were obtained from the 6 sites summarized in the abstract by Porco *et al.*, and excellent data on the atmosphere and rings were also obtained at the 2.1m telescope of the Mexican National Observatory (San Pedro Martir, BC), at a wavelength of 3.2 μm ($\Delta\lambda = 0.05$ μm).
Saturn atmospheric immersion data for Chile were affected by simultaneous transmission through the C ring. Immersions observed from the terrestrial northern hemisphere appear to be uncontaminated by the C ring. All emersion events were clearly observed without ring interference. Although central flash events may be contained in the data sets, initial inspection of array data suggests strong suppression of any central flash, either by ring interference, by absorption, or by strong defocusing by temperature gradients.
Preliminary fits to MMT and 61" emersion data yield a Saturn scale height of ~70 km at a pressure level of ~1 μbar. This level is extremely well calibrated to the center of 9 circular ring features observed on ingress and egress, and whose radii are determined from Voyager data. After correcting for refraction and general-relativistic ray bending, this emersion level, which is near Saturn's equator, is found to be at a projected sky-plane distance of 61050 km from the center, or approximately 400 km above the highest atmospheric level probed by Voyager radio-occultation (0.2 mbar).
This work has been supported by NASA grants NAGW-1555, NAGW-960, and NSF grant AST-8715373.

12.02 OBSERVATION OF THE JULY 3, 1989 STELLAR OCCULTATION BY SATURN AND ITS RINGS.

A. Brahic, B. Sicardy, F. Roques, C. Ferrari and I. Grenier (Université Paris VII and Observatoire de Paris)

The spectacular occultation of the bright star 28 Sagittarii by the Saturnian system has been observed under good seeing conditions on July 3, 1989 from the European Southern Observatory (A. Brahic and I. Grenier) using simultaneously two telescopes (2.2m and 1m) while the occultation by Titan was observed from Paris Observatory (F. Roques et al.) and from Pic du Midi Observatory (B. Sicardy et al.). 28 Sagittarii is by far the brightest star (K-magnitude 1.4) yet predicted to be occulted by Saturn. The star had an apparent velocity of 20.2 km/s. The observation has been made using a CVF filter centered on 3.4 microns in