

Remote Raman Spectroscopy and Elastic Lidar Systems

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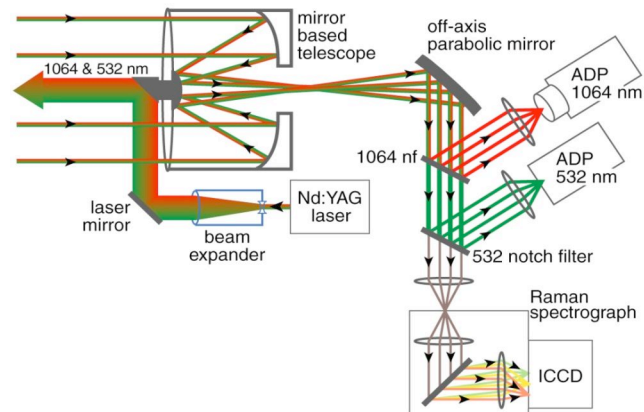
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Remote Raman and Elastic Lidar Parameters

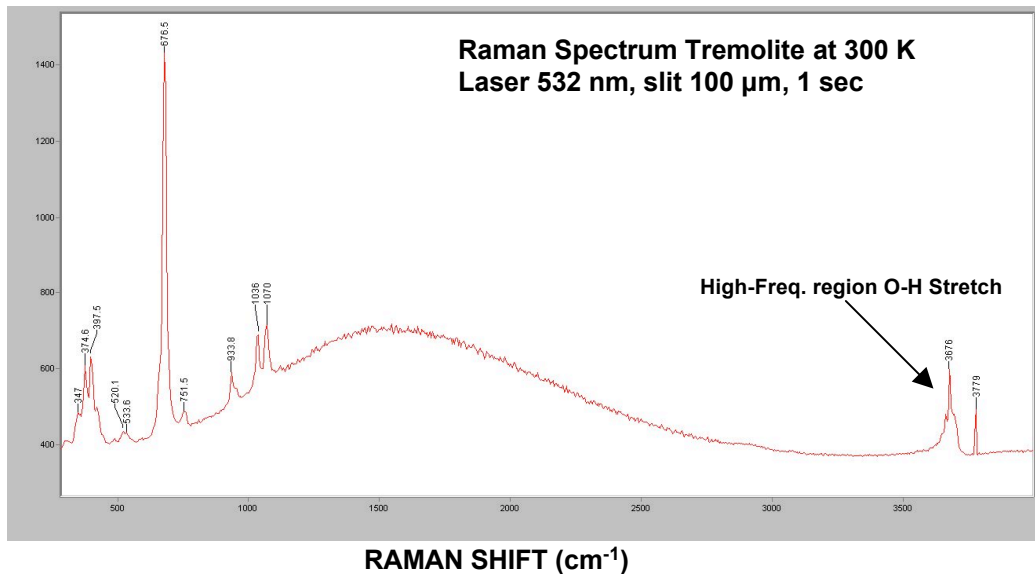
Mini-Laser (FiberTek)		I-CCD Photonic Science		Si-APD C30902S (Perkin-Elmer)	
Wavelengths	1064, 532, 355 nm	Active Pixel area	1392x1064	Active Diameter	500 μm
Energy per pulse (before conversion)	45 mJ @ 1064 nm	Pixel Size	6.45x6.45 μm^2	Dark Current	10 nA
Pulse Energy (after conversion)	~13.4mJ@1064nm, ~16.7 mJ@532nm, ~13.3 mJ@355nm	Spectral Range	385 to 795 nm	Spectral Range	400 to 1064 nm
Pulse Rate	1 – 20 Hz	Quantum Efficiency	69%(typical) @500-600 nm	Peak Sensitivity	830 nm
Pulse width	5 - 10 ns	Dimensions Approx.	120 mm long 50 mm diameter	Gain	250
System Volume	< 1600 cm ³	Power	1.6 watts	Power	30 μ -watt
Mass	2.1 Kg	Mass	<400 g	Mass	350 g

Schematic Diagram



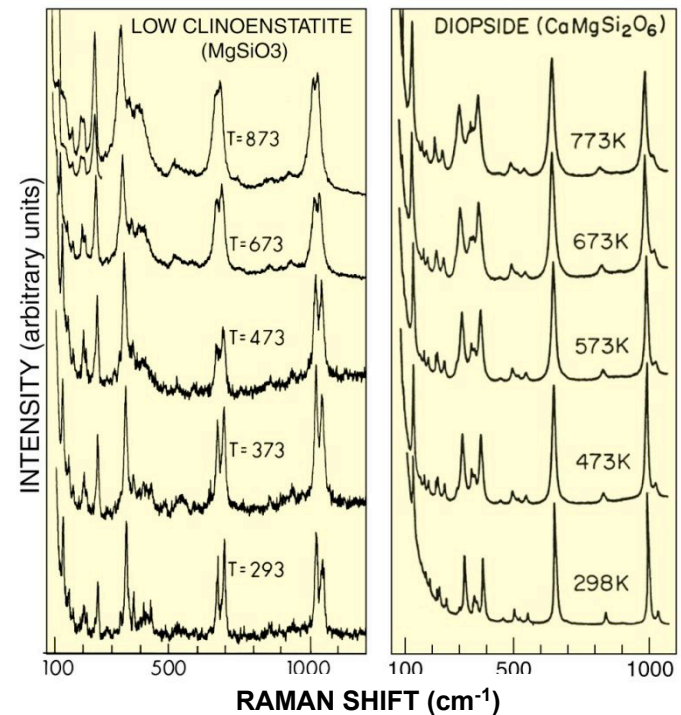
Raman Spectra of Amphibole & Pyroxenes

In the past, if water was present on Venus some of the amphiboles may still be stable on the planet surface. Amphiboles, other hydrous minerals and their alteration products can easily be detected from their finger-prints in the Raman spectra .



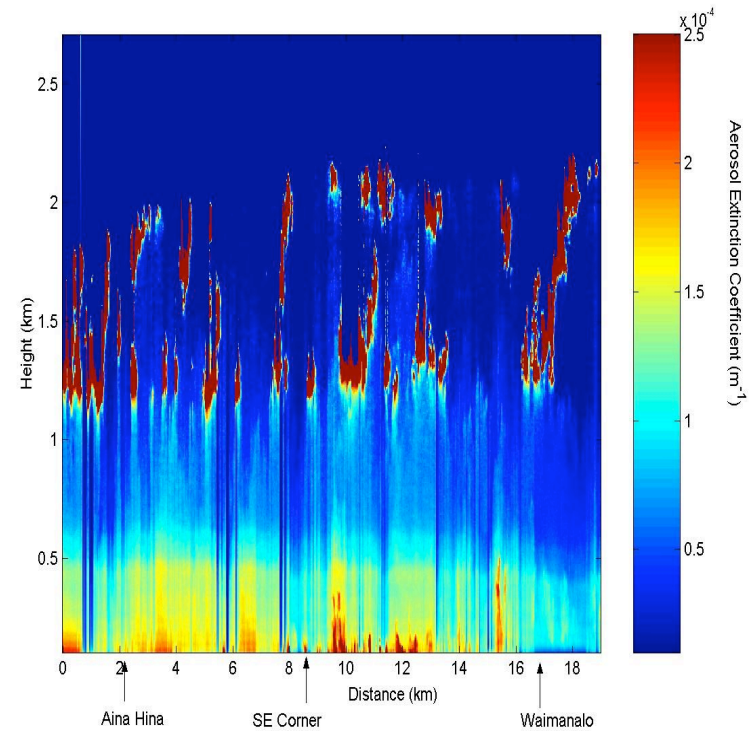
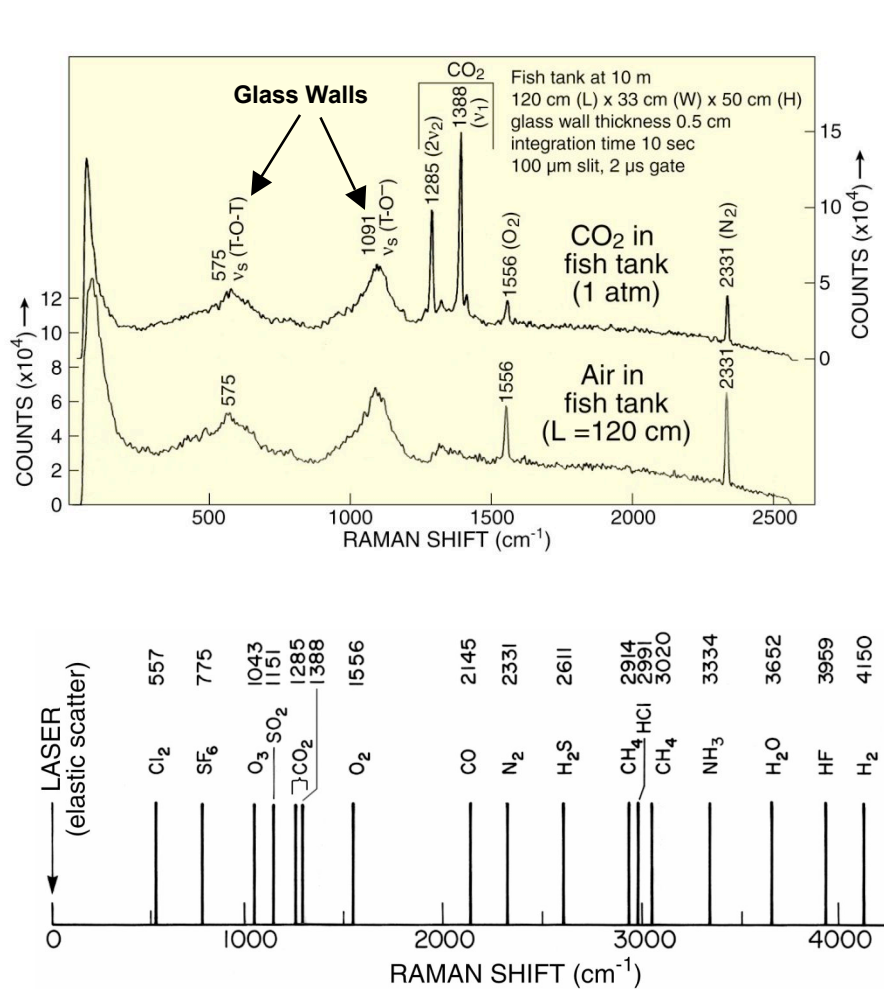
Heated at 1073 K (CO₂ & N₂ atm) over 3 yrs period.
 $\text{Ca}_2\text{Mg}_5\text{Si}_8\text{O}_{22}(\text{OH})_2 = 2\text{CaMgSi}_2\text{O}_6 + 3\text{MgSiO}_3 + \text{SiO}_2 + \text{H}_2\text{O (gas)} \dots\dots\dots(1)$
 Tremolite (Amphibole) (diopside + Enstatite) + high T silica phase + Water (v) (Dp40En60)

(Johnson and Fegley (2003) *Icarus* 164, 317–333)



Venus Surface P = 92 Atm., T = 723-753K
 At Venus surface the Raman lines of minerals will be sharp and distinct.

Combined Remote Raman & Elastic Lidar Data



Aerosol scattering coefficient derived from lidar data around SE Oahu. Clouds are shown in dark values (Sharma et al., 2003). Laser 532 nm, 12 mJ/pulse, 20 Hz.

Backscatter Lidar From an Orbiting Platform

- Heritage based upon NASA Calipso and LITE missions
- Low orbit altitudes (~400 km) desirable
- High vertical resolution, multi wavelength (1.06, 0.532, and 0.355 μ), and depolarization measurements
- Day/night operation
- Vertical profiles of aerosols and cloud distributions
- Combination with passive sensors will provide information on 3-D distributions
- Precise ranging will allow simultaneous surface ranging at 1.06 μ (MOLA, GLAS)