Serpentinite in Sri Lanka: Preliminary petrological and geochemical constraints and implication for Martian comparisons. Y.X. Wang[1], D.J. Ouyang[2], P. Dharmapriya[3], R. Chandrajith[3], H.M.T.G.A. Pitawala[3], S. Karunatilake[4], E. Hughes[5], M. Vithanage[6], T. Edussuriya[7], K. Anandakiththi[8], J. Wray[5], F.R. Hernandez[5], M. Melwani-Daswani[9], S. Perl[9], A. Sarbadhikari[10], Y.T. Shi[1], L. Xiao[1]* (longxiao@cug.edu.cn). [1]China University of Geosciences, Wuhan, PRC; [2]Nanjing University, PRC,[3]Department of Geology, University of Peradeniya*; [4]Geology&Geophysics, Louisiana State University**; [5]Georgia Institute of Technology**; [6]Ecosphere Resilience Research Center, University of Sri Jayewardenepura*; [7]Faculty of Medicine, University of Kelaniya*; [8]Department of Linguistics, University of Kelaniya*; [9]NASA-JPL, Caltech**;[10] Physical Research Laboratory, India. *Sri Lanka; **USA

Introduction: The intricate interplay of materials and energy within serpentinite environments underscores their significance in deciphering water-rock interaction processes, thereby serving as key indicators for biomarker exploration and assessing the potential habitability of Mars [1,2]. Current work on Martian serpentinite mainly relies on remote sensing [3,4,5,6] and analogue studies [2,7,8]. However, many outstanding questions remain, such as the decomposition of serpentine mineral assemblages under variable fluid pressure-temperature conditions [9]. This also leads to poorly constrained stability fields of serpentine group minerals [10]. Here we adopt a comparative planetology approach in Sri Lanka's serpentinite bodies, to also inform future Mars exploration.

Lanka is situated within the equatorial belt in the northern Indian Ocean [11], with an average annual temperature exceeding 20℃. The precipitation exhibits significant seasonal and interannual variations. The serpentinite outcrops at the boundaries of the Highland and Vijayan complexes (HC-VC) [12], denoted as the Lanka Serpentinite Bodies (LSBs), exhibit varying degrees of serpentinization, indicating complex hydrothermal processes, protolith materials, and fluid composition [13] about 480 Ma ago [14]. The overall paleo-geology makes the LSBs a compelling reference for investigating serpentinization in the Martian crust. Through petrological and mineralogical analysis of samples collected from 5 locations (Rupaha, Ginigalpalessa, Indikolapalessa, Ussangoda, Yudhaganawa) along the HC-VC boundary, we have characterized mineral serpentine mineralogy and analyzed their structural characteristics. We will further elucidate the genesis of serpentinite through geochemical methods, providing indications for potential mechanisms in the Martian serpentinization process.

Methods: The initial petrographic observation was conducted using a polarizing microscope model PM6000. To conduct a comprehensive analysis, we selected 15 representative samples (including 5 study area) that exhibited varying degrees of erosion and were less affected by later erosion. For the analysis of major and trace elements in the bulk rock, we used the X-ray fluorescence spectrometer (XRF) ZSX primus II and the Agilent 7700e ICP-MS. The quantitative analysis of in-situ major elements of minerals was completed by using an electron probe microanalyzer.

Field observations and thin section analysis: All serpentinites in the study area have undergone moderate to strong serpentinization and subsequent alteration. Severely weathered serpentinites are mostly fragmented, with a grayish-black surface and underlying grayish-green material. Less weathered rocks are light green in color (Fig. 1). The major minerals include olivine, pyroxene, serpentinite, etc.; secondary minerals include magnetite, spinel, etc.; the accessory mineral is magnesite (Fig. 2). Changes in mineral composition are mainly controlled by the source rock and the intensity of weathering.

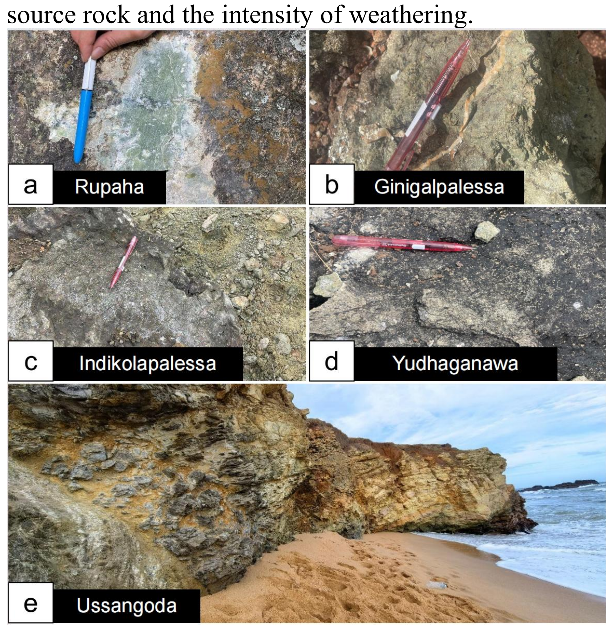

Fig. 1. *Typical field photos in the study area. a) Pale green serpentinite; b) Serpentinite containing flint veins, with visible remnants of pyroxene; c) Grayish-black serpentinite; d) Dark green serpentinite, relatively fragmented; e) Serpentinite and basic country rock profile exhibits alternating red-green bedding.*

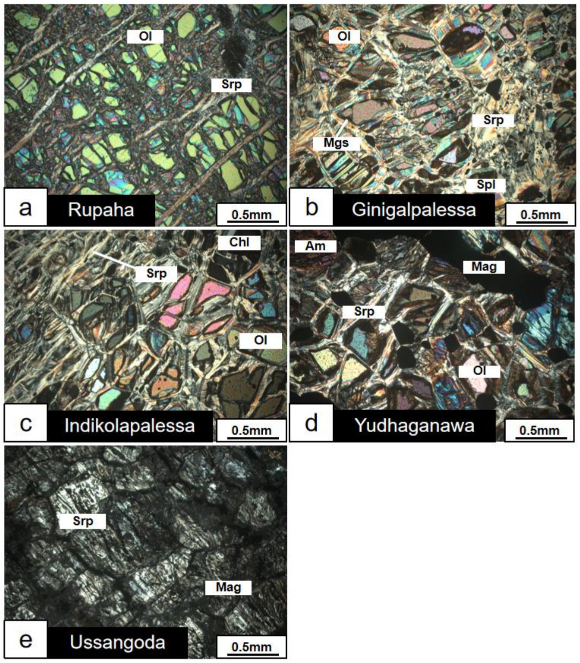

Fig. 2. *Photomicrographs showing representative samples within the research area. a) Serpentine veins; b) Olivine in pseudocrystalline structure; c) Olivine in residual metasomatic structure; d) Olivine in residual metasomatic structure; e) Serpentine in fiber interwoven structure green bedding.*

All 15 serpentinite samples examined in this study exhibit significant total rock loss on ignition. Rupaha serpentinite exhibits the lowest LOI at an average of 9.60 wt.%, while Indikolapelessa serpentinite exhibits the highest LOI at 21.49 wt.%, which may be affected by different volatile components. The ternary diagram of the bulk rock major elements indicates that magnesium-rich serpentinite bodies in Sri Lanka may have typical refractory characteristics of upper mantle peridotite (Fig. 3). There is a negative correlation between SiO_2 and MgO, possibly due to the dissolution of brucite during serpentinization and the later weathering process (Fig. 4).

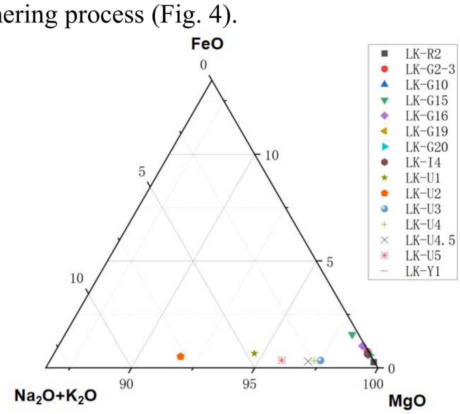

Fig. 3. *Ternary diagram of Lankan serpentines with representative samples. (R-Rupaha; G-Ginigalpelessa; I-Indikolapelessa; U-Ussangoda; Y-Yudhaganawa).*

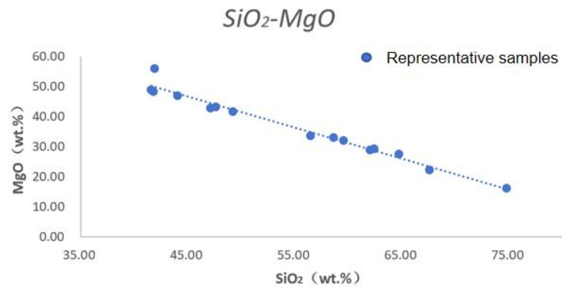

Fig. 4. *Major element variation diagrams showing the relations of SiO_2-MgO in the examined representative samples.*

Conclusions & Future works: The stable mineral assemblages and composition characteristic of altered rocks can indicate certain physical and chemical conditions [16]. Based on petrology and bulk rock geochemistry research, we have preliminarily quantified the relative extent of secondary minerals in the primary mineral assemblages of serpentinite and understood the information of the serpentinite protoliths. Therefore, in future research, we hope to obtain more information on the migration and enrichment of elements in different minerals, which will help us deepen our understanding of the alteration process and interpret the mineral phase transition process.

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