CONTEXTUALIZING MARTIAN PETROGENETIC CONSTRAINTS FROM CHROMITE WITH ULTRAMAFIC ROCKS OF SRI LANKAN SERPENTINITES. K.T.P. Jayaweera[1], P.L. Dharmapriya[1] (prasannad@sci.pdn.ac.lk), R. Chandrajith[1], S.P.K. Malaviarachchi[1], S. Karunatillake[2], K. Sajeev[3], H.K.D.V. Gunasekara[1], J. Wray[4], A. Sarbadhikari[5], L. Xiao[6], K. Anandakiththi[7], S. Perl[8], M. Melwani-Daswani[9], F. Rivera-Hernandez[4]. [1]Department of Geology, University of Peradeniya, Sri Lanka, [2]Geology & Geophysics, LSU, USA, [3]Center for Earth Science, Indian Institute of Science, Bangalore, India. [4]School of Earth and Atmospheric Sciences, Georgia Institute of Technology, USA. [5]Physical Research Laboratory, Ahmedabad, India, [6]China University of Geosciences, Wuhan, China. [7]Faculty of Humanities, University of Kelaniya, Sri Lanka. [8]Blue Marble Space Institute of Science, Washington, USA, [9]California Institute of Technology, USA.

Introduction: Variations in chromium abundance in Martian lithology can inform igneous evolution as a function of partitioning [e.g.,1,2]. While also characterized in situ as at Gusev Crater, the specific processes – extending to aspects like melting stages of the Martian mantle – remain poorly constrained. Here we consider potential analog insight in Sri Lanka, which formed in the ancient supercontinent Gondwana and experienced peak metamorphism ~550 Ma ago [3,4]. Lanka notably hosts serpentinized and carbonated ultramafic bodies that postdate (plate)tectonic suturing, including in Yudhaganawa, Katupotha, Indikolapelessa (I), Ginigalpelessa (G), and Ussangoda (U) [4]. Lankan serpentinites are considered potential analogs for Martian Mg-serpentines [5,6]. Elucidating the petrogenesis of source rocks of Lankan serpentinites, through the mineral chemistry of chromite, may inform Martian mantle investigations as well.

Results: The serpentinites are predominantly Mg-rich serpentine, with relict olivine fragments embedded in the serpentine matrix. Magnesite-rich veins of varying thickness and disseminated magnesite occur in thin sections. Petrography reveals chromite as a minor to accessory mineral. Its mineralogy was analyzed at the Center for Earth Sciences, Indian Institute of Science, Bangalore, India under Electron Probe Micro Analyzer. Data of studied chromite is indicated in the table 1.

Table.1 Mineral chemical data of studies chromite

Chemical parameter	U	G	I
Cr# [(Cr/(Cr+Al)]	0.04-0.85	0.70-073	0.66-0.74
Mg# [Mg/(Mg + Fe)]	0.31-0.35	0.29-0.31	0.22-0.28
TiO_2 wt.%	0.00-0.10	0.15-0.25	0.00-0.33
Fe^{2+}/Fe^{3+}	2.90-3.50	1.07-1.42	0.86-1.21
(Fe/MgO)melt [after 7]	2.97-3.39	5.22-5.29	5.92-5.17

Discussion: The chemical composition of chromite, including Mg^{2+}, Cr^{3+}, Fe^{3+}, Fe^{2+}, and Ti^{4+}, provides valuable insights into the tectonic setting, magmatic affiliations, and physicochemical conditions of the host rocks [8]. High Cr# and low Al_2O_3 content in chromites indicate extensive partial melting of a mantle source, typical of arc-related ultramafic rocks. This extensive partial melting is corroborated by the low TiO_2 wt.% in chromite. Discrimination diagrams (Cr/Cr + Al vs. Mg/Mg + Fe^{2+}) [9], TiO_2 vs. Al_2O_3 [10], and Fe^{2+}/Fe^{3+} vs. Al_2O_3 [10] suggest a Supra-Subduction Zone (SSZ) tectonic environment for the source ultramafic rocks of the studied serpentinites [8]. The presence of serpentine and magnesite points to significant interaction with water and CO_2-rich fluids, characteristic of SSZ environments where fluids are released from the subducting slab [3]. High Cr# in chromite indicates significant degrees of partial melting, consistent with SSZ environments influenced by fluid interaction [9]. Low TiO_2 in chromite suggests a depleted mantle source, as expected in SSZ settings [10]. The range observed is not typical for highly refractory SSZ peridotites, which generally exhibit higher Mg# due to extensive melt extraction. This discrepancy could be attributed to the redistribution of Mg in chromite during cooling. Chromite spinels have been documented in Martian meteorites. Chromite data from the Martian dunite meteorite Northwest Africa (NWA) 2737, with Cr# values of 0.78 and 0.67 and Mg# values of 0.28 [11], partially resemble Lankan chromites. Therefore, further investigation of mineral chemical and the spectroscopic characteristics of chromites in Sri Lankan serpentinites, using methods such as Raman spectroscopy, could provide valuable insights into Martian mantle differentiation processes, magmatic history, enhancing our understanding of the geologic history and evolution of Mars.

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