Water and Chlorine abundances within distinct geological units in Gale crater. **M. V. Djachkova**[1], S. Y. Nikiforov[1], I. G. Mitrofanov[1], M. L. Litvak[1], D. I. Lisov[1], A. B. Sanin[1], [1]Space Research Institute of the Russian Academy of Sciences (IKI), 117997, 84/32 Profsoyuznaya st., Moscow, Russia, djachkova@np.cosmos.ru.

Introduction: For more than 10 years, NASA MSL Curiosity rover has been successfully traversing across Mars surface exploring Gale crater. The surface of Gale crater is known to be heterogeneous in its composition, and the traverse of the rover crosses distinct geological units (GU). The units were identified by the MSL Team using the totality of data available from Curiosity and other missions (see [1, 2]).

This work presents results on the assessment of Water Equivalent Hydrogen (WEH) and Absorption Equivalent Chlorine (AEC) data for such units, gathered by the Dynamic Albedo of Neutron (DAN) instrument onboard NASA's Curiosity rover [3 – 6].

Instrumentation: We analysed 27,100 meters of the path traversed of Curiosity. DAN team provided pixel map of DAN measurements for estimations of WEH and AEC along the traverse. These data were associated with 10061 pixels, and each pixel has been assigned to a particular geologic unit (GU) in accordance with MSL stratigraphic column for the sedimentary units [1, 2].

The mission science team divided observed geology into 5 major groups that include 14 distinct GUs in order of the first appearance along the traverse of Curiosity, covered until December 2021. In our work, we have identified additional type of surface, where the rover traverse runs through areas fully covered with sand. They are not associated with a distinct GU on the stratigraphic coloumn. In our study, these areas are grouped together as a single 'Sand' GU.

Data Analysis: The sequence of active DAN measurements of WEH and AEC in distinct GUs along the Curiosity traverse are shown in Figure 1 [6-8]. Data is presented in a boxplot-like manner. The color-filled box extends from the first to third quartile of values of the data, with a bold line at the median. The non-filled boxes extend from the edges of minimum and maximum values to show the range of the data. 'Sand' and 'Stimson' pixels are distributed along the entire path, the remaining geological units are presented in the order of the rover traverse.

Results: The distributions in Figure 1 show that some regions are similar and others differ from each other according to the data of WEH and AEC. The large fraction of GUs have mean WEH values between 2 and 3 wt.%; they are Bradbury, Sheepbed, Pahrump Hills, Hartmann's Valley, Karasburg, Sutton Island, Blunts Point, Pettegrove Point and Mercou. The Sand GU has the lowest mean value for WEH equal to 2 wt.%. On the other hand, there are five GUs at the second part of traverse, namely Jura, Knockfarrill Hill, Glasgow, Pontours, that have the mean values of WEH above 3 wt.%. Generally speaking, one may conclude that all GUs at the second part of traverse, except Mercou, have larger values of WEH than GUs under Vera Rubin ridge.

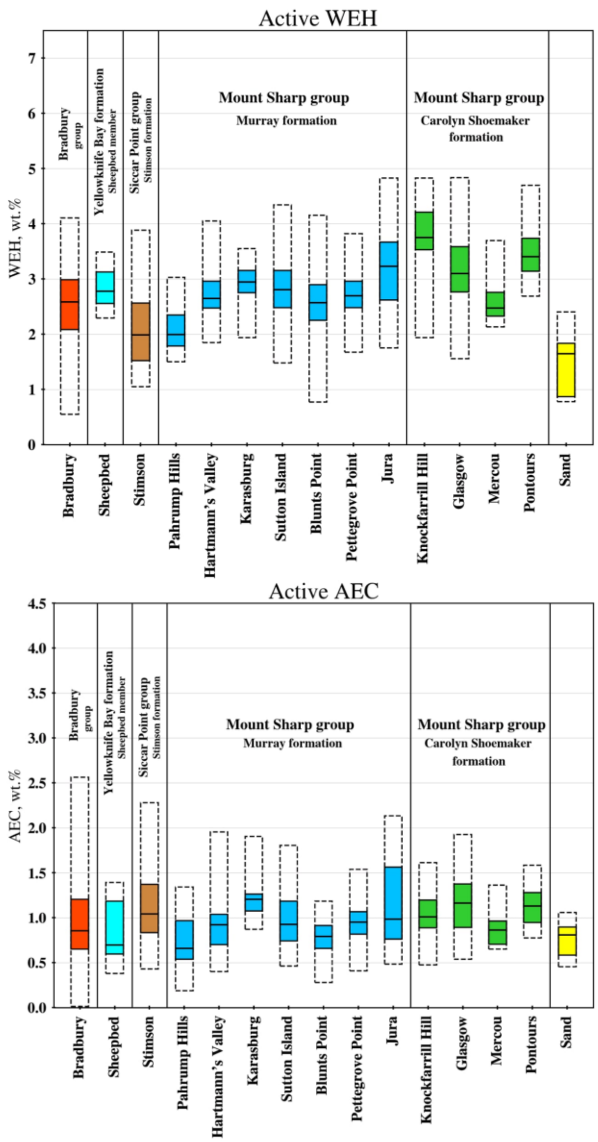

Fig. 1. WEH (up) and AEC (down) distributions within GUs along 27 km of the Curiosity traverse. The filled boxes extend from the first to third quartile of values of the data, with a bold line at the median. The non-filled boxes extend from the edges of minimum and maximum values to show the range of the data.

There are no large variations of the mean AEC values for all tested GUs, they all are around 1 wt.%. Variations of AEC within individual GUs are usually large, larger than variations of WEH between GRs (see more details in [9]).

Discussion: Based on the DAN measurements, the Jura member of the Murray formation can be divided into two parts. DAN measurements and WEH distribution in the Jura member of Murray formation are presented in Figures 2 and 3.

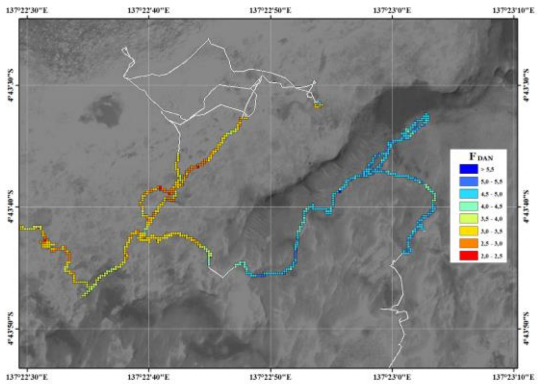

Fig. 2. Figure shows the rover's traverse path through Jura, Pettegrove Point and Knockfarril Hill members. Pixels of Jura member are filled with F_{DAN} parameter values (ratio of counting rate of two DAN detectors, see [5] for more details), other members are shown with white line.

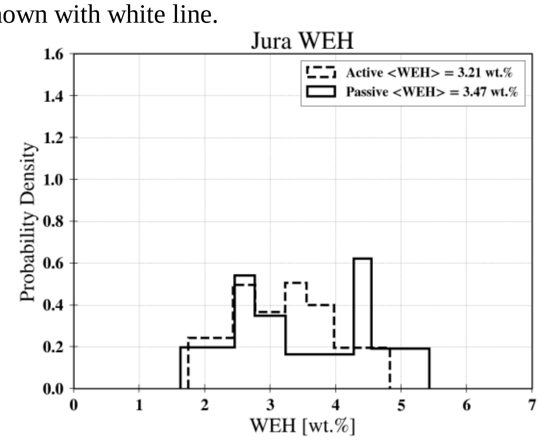

Fig. 3. WEH distribution within the Jura member.

As it is clearly visible in Figure 2, the values of F_{DAN} are different for two segments of traverse for Jura GU before and after the traverse mark of ~ 20 km. One might guess that the Jura member might be split according to WEH content into two distinct GUs: the part corresponding to Jura/VeraRubin ridge (Jura VRR), and the part corresponding to Glenn Torridon region (Jura GT). The distributions of WEH are presented in Figure 4. They are clearly distinguishable. Their mean values differ significantly: from 2.78 wt.% to 3.94 wt.% for active measurements, and from 3.08 wt.% to 3.81 wt.% for passive measurements [6, 8]. The reason for the difference is thought to be attributed to the large fraction of clay minerals (up to 20 wt.%) in the Glen Torridon part of the Jura member.

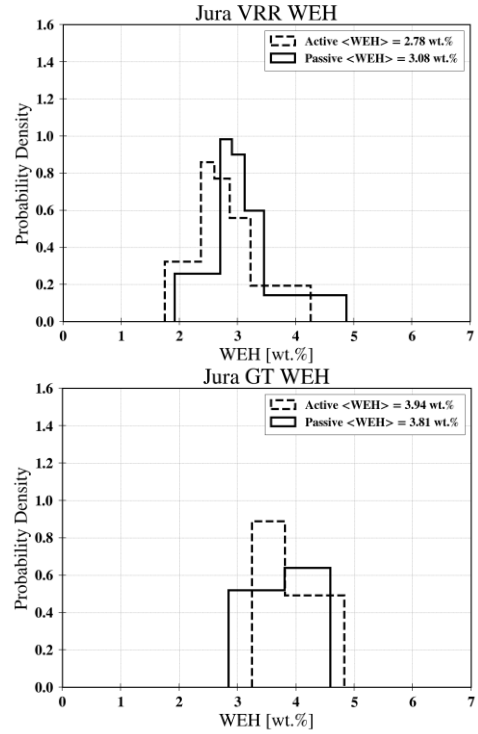

Fig. 4. WEH distribution in the "first part" of Jura member (up) – on Vera Rubin ridge and in the "second part" of Jura member (down) – in the Glen Torridon region.

References: [1] Fedo, C.M. et al., (2022). *JGR*, 10.1029/2022JE007408 [2] Rampe, E. B. et al., (2020). *Geochemistry*, 10.1016/j.chemer.2020.125605 [3] Mitrofanov, I.G. et al. (2014) *JGRE*, 10.1002/2013JE004553. [4] Livak, M.L. et al. (2014) *JGRE*, 10.1002/2013JE004556. [5] Nikiforov, S.Y. et al. (2020). Icarus, 10.1016/j.icarus.2020.113818 [6] Mitrofanov, I.G. et al., (2022). *JGR*, 10.1029/2022JE007327. [7] Nikiforov et al., (2023) this conference. [8] Nikiforov et al., (2023) submitted to JGR:P. [9] Litvak et al., (2023) this conference .