CONNECTING FLUVIAL LANDFORMS AND THE STRATIGRAPHY OF MAWRTH VALLIS PHYLLOSILICATES: IMPLICATIONS FOR CHRONOLOGY AND ALTERATION PROCESSES, N. Mangold[1], D. Loizeau[2], A. Gaudin[1], V. Ansan[1], J. Michalski[2], F. Poulet[2], J-P. Bibring[2], [1] Laboratoire de Planétologie et Géodynamique de Nantes, Université de Nantes/CNRS UMR6112, 2 rue de la Houssinière, BP 92208, 44322 Nantes, France (nicolas.mangold@univ-nantes.fr), [2] Institut Astrophysique Spatiale, Université Paris-Sud/CNRS, UMR 8617, 91405 Orsay, France.

Introduction:
A layered phyllosilicate-bearing bedrock is widely exposed in the Mawrth Vallis region of Mars [1, 2]. The light-toned rocks can roughly be divided into a Fe/Mg-phyllosilicate-bearing unit, and an Al-phyllosilicate-bearing unit [2]. Local exposures of crater rims show that the whole layered unit is > 150 m in thickness, but this thickness may exceed 1 km if assuming the plateau being cut by the Mawrth Vallis outflow [2, 3]. However, more recent studies suggested that the layered deposits were formed after the Mawrth Vallis outflow channel, therefore being limited in thickness and being posterior to the outflow (dated of the Late Noachian or later) [4]. The cross-cutting relationships between the outflow channels and the layered bedrock are therefore important for establishing the chronology of events and the thickness of the altered unit. Moreover, fluvial valleys incising the bedrock may also inform us about the role of surface weathering in the formation of phyllosilicates. Thus, this work is motivated by understanding genetic and chronological relationships between fluvial landforms and altered rocks.

Observations on outflow channel slopes:
Previous observations indicated the presence of local layering on valley slopes outcrops, but most high resolution images show dark mantling material hiding the bedrock. New HiRISE and CTX images of the valley slopes and bottom reveal the presence of extensive layers eroded by the fluvial flow. One location at the foot of the valley displays >40 individual layers with subhorizontal dip present over a 120 m high section with a 5° slope. This location being found 500 m below the plateau top, it indicates that the layered deposits were thick, i.e. >600 meters.

Observations at outflow channel bottom:
The channel bottom displays several landforms that we interpret as related to the outflow channel activity in a periglacial environment. Small (few 100s m to 2 km large) closed depressions in the valley floor are interpreted as alases, i.e. thermokarstic depression due to the presence of melting ice at this location. Similar depressions are observed on the floor of Ares Vallis and in Siberia [5]. Polygonal cracking, at the scale of > 100 m, indicates the presence of water ice in the bedrock. These cracks cross all the layered unit present at the valley floor showing that they formed later than the sediments. These large cracks are uniquely found at the valley bottom, therefore implying a genetic link between the valley formation and the periglacial activity. Finally, blocks of layered deposits tilted in various dips were found throughout the valley bottom at different locations. These blocks are interpreted as having been transported by the fluvial activity. Their geometry fits that of blocks found at the bottom of Holden valley and formed either by the deposits of Uzboï vallis activity, or hydraulic fracturation [6]. In both cases, this indicates a formation and induration before the outflow channel activity, as well as their alteration into Fe/Mg phyllosilicates. Nevertheless, in several locations, the Al-bearing material appears "unconformably" over the tilted layers, therefore attesting of possible post-Mawrth Vallis alteration too for the Al-bearing material only. This suggests that the compositional layering is distinct from the depositional layering.

Observations of valley networks incision:
Valley networks are observed as deep valleys in places, or inverted channels in other places. Many valleys cross the slopes of Mawrth Vallis flanks, thus showing an activity subsequent to the outflow. These valleys are poorly branched, but attest of significant late fluvial activity. It was observed that these valleys are only present in locations where a Al-bearing phyllosilicates unit was present, thus at the top of the layered unit.

Conclusions:
New observations show (1) the presence of Fe/Mg phyllosilicate-bearing layers deep inside the Mawrth valleys slopes, attesting of a >600 m thick layered unit, (2) the erosion of Mawrth Vallis took place after the main episodes of layer deposition and alteration into Fe/Mg phyllosilicates, (3) the alteration having produced Al-rich material may have occurred later than the outflow formation. This late alteration may be due to a late weathering phase related the late fluvial activity as suggested by the association of fluvial landforms with Al-bearing outcrops.

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