GEOPLANET IO10

FIELD DATA COLLECTION

The Intellectual Output of Field data Collection consists of a series of photogrammetric models carried out by the students during the Predazzo session of the School on Planetary Geological mapping and Field Analogues.

In particular, during the school each participant acquired with his/her smartphone camera objects present in the Geological Museum of the Dolomites exhibition (minerals, rocks, models of ancient dinosaurs) and generated its 3D reconstruction with Agisoft Metashape. In this way, the students were able to acquire the needed experience in 3D photogrammetric acquisitions and reconstructions in a controlled environment before proceeding with the acquisitions directly in the field. The indoor strategy of acquisition was to locate the shots all around and at the same distance from the object of interest paying attention to not varying the zoom level and maintaining at least 80% of overlap among contiguous images.

The data acquired indoors have been processed in the classroom by using Agisoft Metashape which follows a Structure From Motion (SFM) approach in creating 3D reconstruction (see Caravaca et al., 2019). Unlike classical photogrammetric work-flows, the SFM does not require a predefined knowledge of the camera position or of the coordinates of known points in the scene since the geometry of the acquisition is directly retrieved from the automatic detection of the same features on different acquired images. The SFM reconstruction foresees the following steps (Fig. 1): 1) Derive the matching points through images alignment and reconstruct a sparse point cloud, 2) Reconstruct a dense point cloud knowing the camera intrinsic parameters and eventual coordinates of its position or/and of objects within the scene, 3) Refine the dense point cloud through confidence assignment and related cleaning, 4) Generate vertices from the dense point cloud and create a triangular mesh, 5) Assign the RGB texture to the dense point cloud and the mesh.
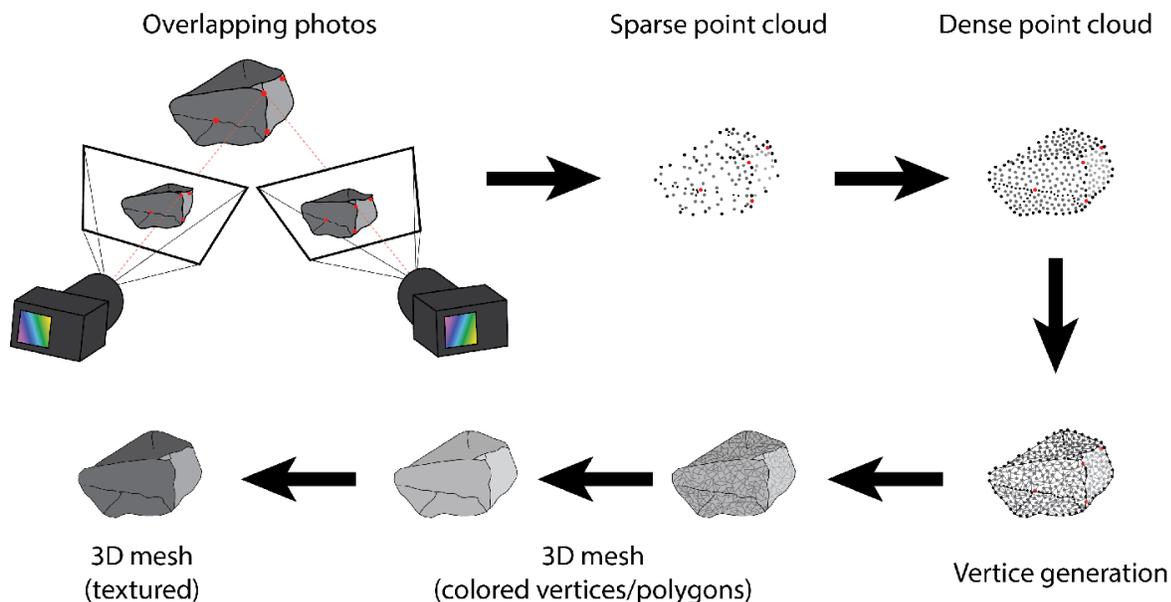

Overlapping photos   Sparse point cloud   Dense point cloud

3D mesh (textured)   3D mesh (colored vertices/polygons)   Vertice generation

Figure 1. SFM work-flow (Caravaca et al., 2019, Deliverable D5.2 of PLANMAP Horizon-2020 project no. 776276)

After this practical session, an entire day was dedicated to a field trip in the Bletterbach gorge, where wonderful vertical exposures of Late Permian fluvial red beds are interleaved by overbank clays and arid soils, dominated by sulphate nodules and veins. This environment is astonishingly similar to the sedimentary sequences found by the Curiosity rover in Gale crater on Mars (see IO 9 Field trip guide). For this reason, the activity was focussed on a vertical outcrop of red beds (up to 30 m high) which was acquired by a dedicated DJI Phantom 4 drone equipped with an RTK (Real Time Kinematic positioning) system for accurate positioning of the flying camera. In addition, the students acquired with their smartphones the base of the outcrop made up of clays interleaved by layers rich in sulphate nodules and intersected by sulphate veins. Since the outcrop was almost vertical, the cellphone acquisitions in the field were carried out with an in-series sequence of shots at the same distance from the outcrop (c.a.5-6 m), with the same viewing angle and zoom level (i.e. fixed focal distance) and paying attention to guarantee a 60 to 80% of overlap between adjacent images.

The Drone acquisitions were carried out after specific planning made up on a lower resolution Digital Outcrop Model in order to keep the drone at a fixed distance of a few meters from the outcrop (typically less than 2m , in order to obtain a high resolution model and texture). This allowed the final product to be comparable with the Digital outcrop models acquired with smartphones.

The same SfM technique applied for the Museum objects was utilised, with the addition of the GPS RTK and smartphone GPS information to correctly georeference the Digital Outcrop model in latitude, longitude, orientation and altitude

The final step was to export the 3D reconstructions in .obj and .ply files finally delivered as IOs.

The 3D spatial data acquired in the field were then imported into VRGS software for 3D geological interpretation and virtual reality immersion with Oculus viewers.

The indoor 3D reconstructions from the Geological Museum of the Dolomites are the following (Fig. 2):

1) Fluorite mineral: Fluorite.obj and Fluorite.ply
2) Quartz Geode: Geode.obj and Geode.ply
3) Reptile: Reptile.ply
4) Desert Rose : Rose.ply
5) Pareiasaurus : Pareia.obj and Pareia.ply
6) Fossil plant: Plant.ply
7) Monzonite rock: Monzonite.ply
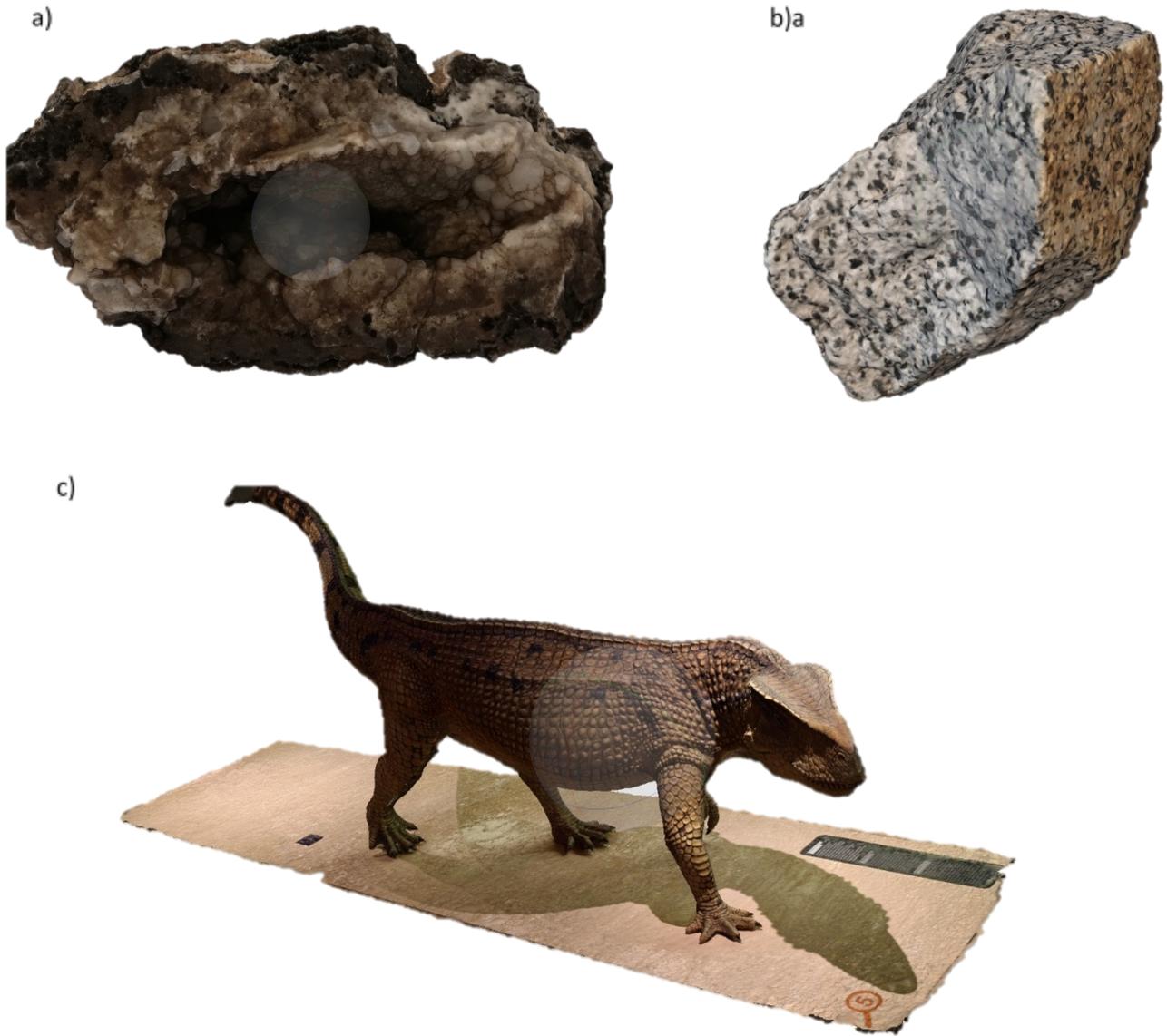
Figure 2 Indoor 3D photogrammetric reconstructions: a) Quartz Geode (Geode.ply); b) Monzonite rock (Monzonite.ply); c) Reptile (Reptile.ply)

The delivered Outdoor Digital Outcrop models from Bletterbach gorge are:

1) Red clays with sulphates nodules and veins acquired from smartphone: bletterbach_outcrop.obj
2) Red beds vertical walls acquired from Drone: Bletterbach_drone.ply
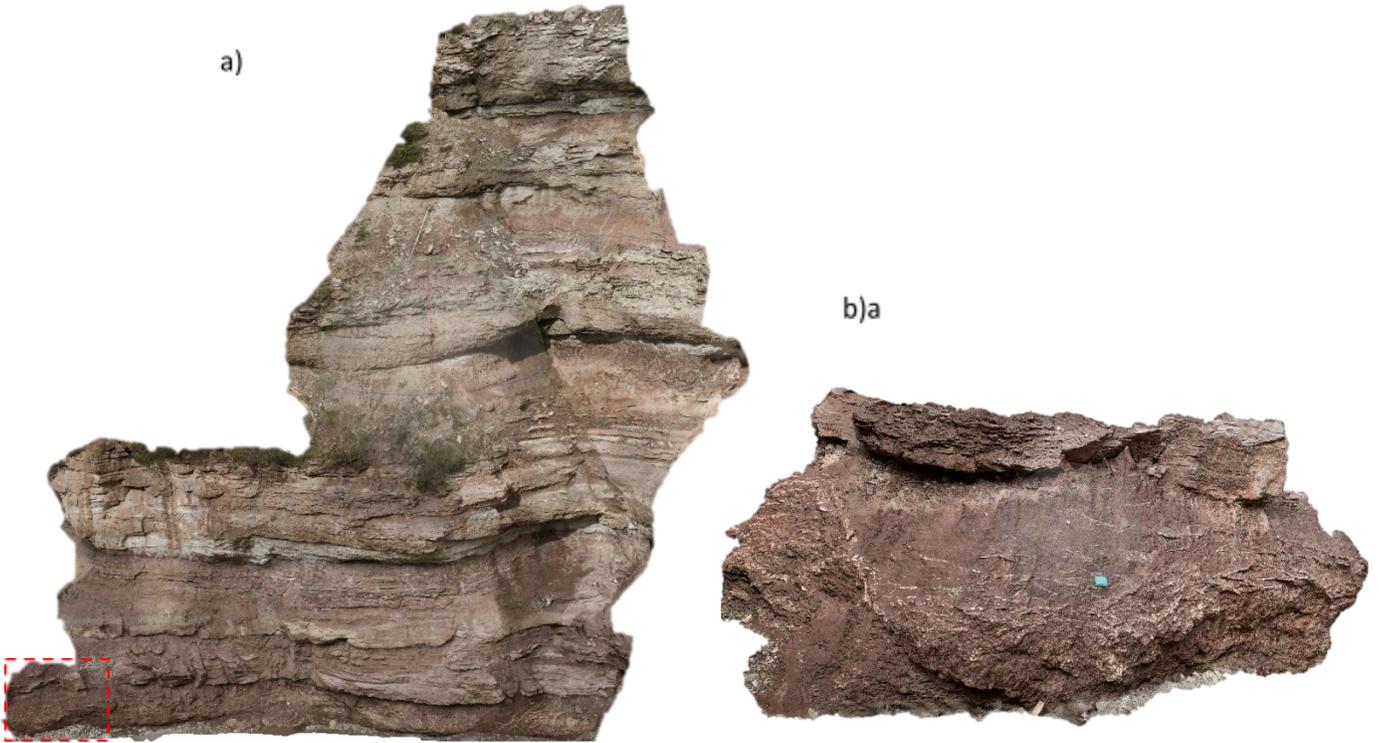
Figure Digital Outcrop Models: a) 30 m high Red beds wall acquired through a planned Drone flight (Blutterbach_Drone.ply). Red dashed square portion reconstructed in b); b) Digital Outcrop Model from smartphone acquisitions (bletterbach_outcrop.obj).

References

Caravaca G., Le Mouélic, S., Mangold, N., 2019, 3D products of the merged GIS and maps of Gale crater, PLANMAP Horizon-2020 project no. 776276.