



# Virtual Field Reconnaissance to enable multi-site collaboration in geoscience fieldwork in Chile.

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## Abstract

The unique challenges of geological mapping in remote terrains can make multi-organisation collaboration challenging. Cooperation between the British and Chilean Geological Surveys and the Chilean National Mining Company used the BGS Digital Mapping Workflow and virtual field reconnaissance software (GeoVisionary) to undertake geological mapping in a complex area of Andean Geology. The international team undertook a pre-field evaluation using GeoVisionary to integrate data and interpret high resolution satellite imagery, terrain models and existing geological information to capture, manipulate and understand geological features and re-interpret existing maps. This digital interpretation was then taken into the field and verified using the BGS digital data capture system (SIGMA.mobile). This allowed the production of a final geological interpretation and creation of a geological map.

## 1) Introduction

Geological fieldwork is resource intensive, and complex terrains can be time consuming to interpret in the field. Techniques which reduce field time and enable better interpretation of the terrain allow increasingly limited resources to be used more effectively. GeoVisionary is software developed by 'Virtallis' in collaboration with the British Geological Survey which enables the user to compile existing data for an area into a 3D environment and to visit the area virtually in 'Virtual Field Reconnaissance' (VFR).



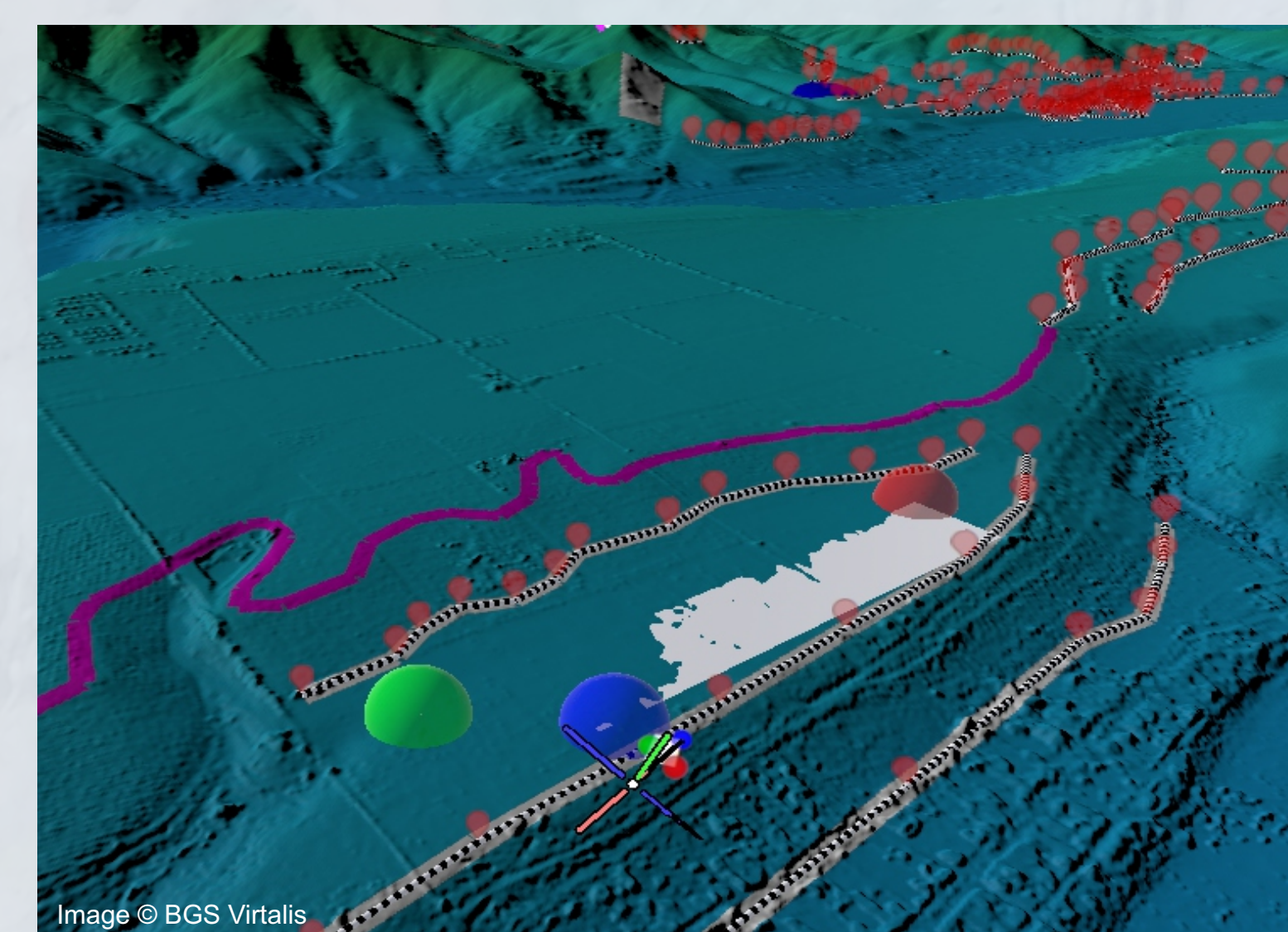
Right: A team of geologists from SERNAGEOMIN, ENAMI and BGS discuss and interpret the terrain to decide field sites to target.

## 2) Purpose

To use 3D visualisation technology to show the Chilean Geological Survey, (SERNAGEOMIN), and ENAMI the range of tools developed at the BGS for geological mapping to augment their existing strategy. The use of terrain models, satellite imagery and 3D manipulation adds to their existing methods. The 3D workflow would be tested in the complex geological terrain of Cerro Negro and El Trapiche in the Ovalle regions of Chile (see map).

The software was used before, during and after the fieldwork to generate new linework and collect geological data. Beforehand points of interest or 'check points' were selected to test the virtual interpretation against the field interpretation.

Below: 3D interpretation of geological units alongside field descriptions and observations.



Above: Using the 3 point plane tool to map out terrace extents in Ovalle.

## 3) Methods

In GeoVisionary geologists can add written observations, lines and interpretations in files with XYZ coordinates, which are easily transferable to digital field systems such as the Arc based 'BGS SIGMA' kit (used in the field). Tools such as the '3-point plane' surface pictured above enabled relative heights of terraces to be shown in relation to fault networks and show locations of potential outcrop across valleys and hillsides. The 'profile generation tool' allowed geologists to identify subtle breaks in slope indicative of a geological boundary.

The fieldwork was conducted in a recently mapped region and it was found that the addition of Virtual Field Reconnaissance improved the existing interpretations.

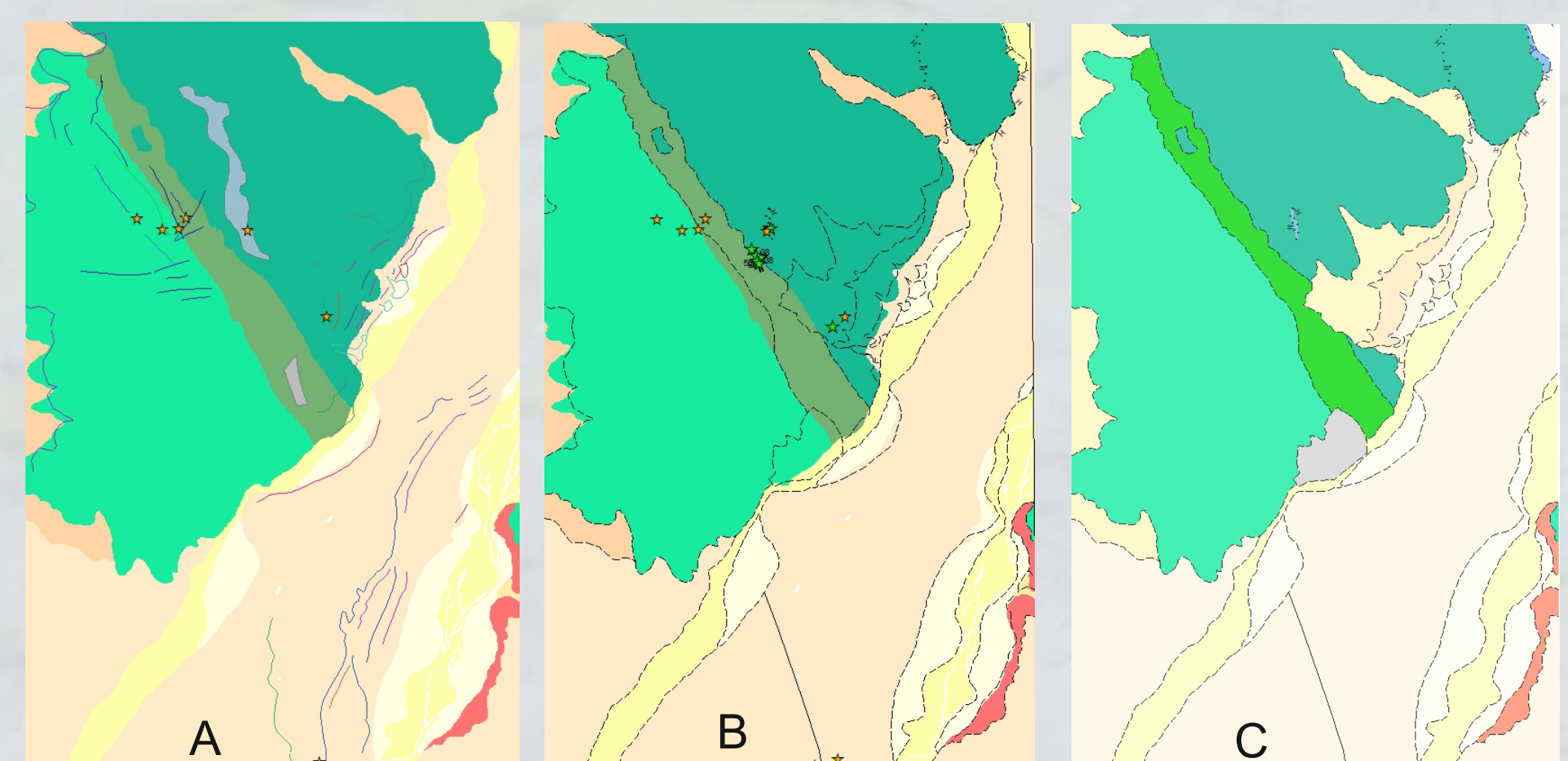
## 6) Conclusions

Three dimensional virtual reality enables a team of geologists to view the field area as a group and make preliminary interpretations before going into the field to ground truth them. This means that geologists go into the field with a good understanding of the underlying geological terrain which they are interpreting. Tools within the software allow the generation of geological data from planes, lines and surfaces which are interoperable with GIS packages such as SIGMA.mobile the BGS field software.

The pre-field generation of points of interest to focus the field effort on saved time so time was not wasted being used in areas which could be interpreted in the software rather than on the ground.

The Chilean Survey were receptive to the workflow and were keen on developing the use of GeoVisionary within their methodology. More information on GeoVisionary and BGS SIGMA.mobile can be found at [www.bgs.ac.uk](http://www.bgs.ac.uk)

Below: The team view and decide on final interpretations post-field visit displaying data collected both in the field and in the office using GeoVisionary



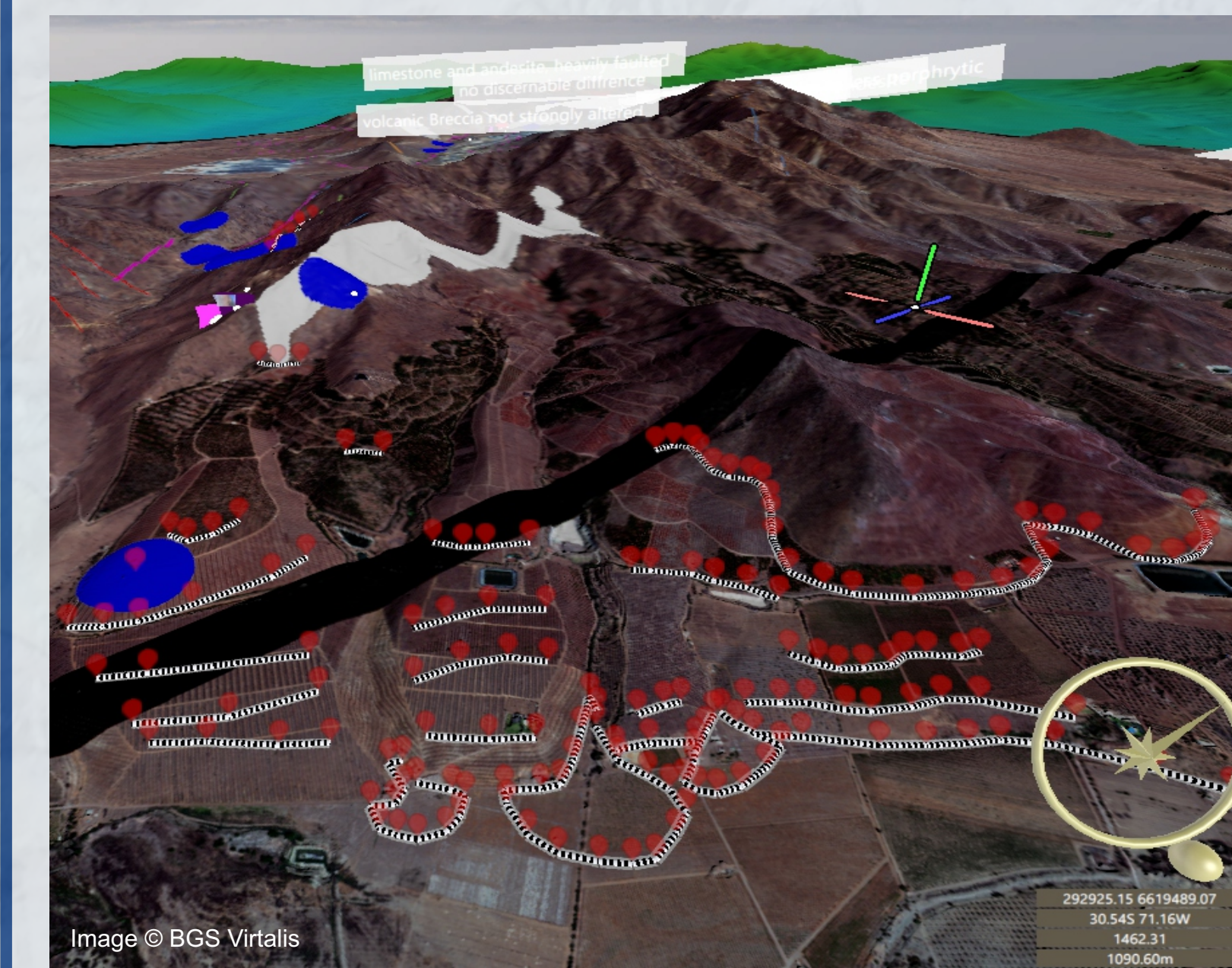
## 5) Interpretations

The three stages of pre-field, field and post field interpretation is shown above, the linework was transferred to Arc GIS in between viewing in GeoVisionary so that it may be used on a tablet PC in the field.

A: Existing geological map for Cerro Negro area overlain with pre-field GeoVisionary interpretations of bedrock boundaries, modern deposit boundaries, geomorphological features, inferred dykes, faults, hydrothermal alteration zones and field check points (yellow stars).

B: Existing map with the addition of field observation points, sites actually visited (green stars) and structural observations as well as new linework from the field.

C: Final compiled geological map for Cerro Negro including additional more recent units such as terraces and fans, greater stratigraphical detail in the superficial units, updated bedrock boundaries in the limestone (green) and structural detail.



## 4) Data and results

The data used in GeoVisionary included 1m, 10m and 30m digital surface models, existing geological maps, high resolution aerial imagery (WV2 and 3, GeoEye) low resolution imagery (Sentinel 2, ASTER, Landsat 8) and shapefiles.

Pre-field interpretations included zones of potentially altered ground, colour changes and changes in slope. Observations and interpretations collected in the field included lithological interpretations and descriptions of units, comments on geomorphology and land use, structural measurements (dip/strike of bedding/joints/faults) and sketches and photographs of areas visited. These were compiled to create an updated geological map.



Right: Adding structural information into BGS SIGMA (ARC toolbar)

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