3.1.1. GEOPHYSICAL DATABASE

Geophysical databases previously created within the INSTEC project has been complemented with the results of the research performed during the third stage, basically containing:

- raw data, as acquired during the field observations on the gravity and geomagnetic field;
- secondary information, as obtained by advanced processing of the raw data.

The stored data is provided in a GIS compatible format in order to be easier asociated with prevously gathered geophysical and/or other kind of information.

3.1.2. GEOPHYSICAL DATA ACQUISITION

Location of the surveyed areas

During the third stage of the project activitie for new geophysical data acquisition focussed on the two main directions: (i) geomagnetic data, and (ii) gravity data.

Fig. 1 shows location of the main areas where field observations on the gravity and geomagnetic fields have been conducted.

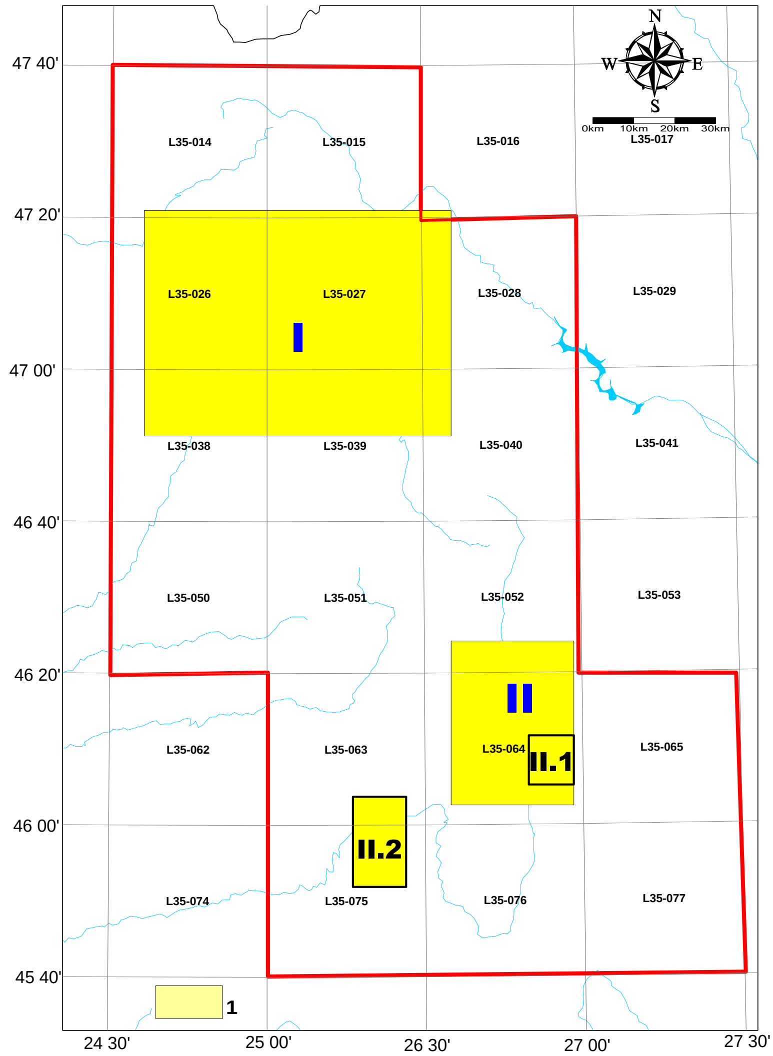


Fig. 1 Location of the areas where new gravity and geomagnetic surveys were conducted
1, searched area; I Călimani region; II, Harghita zone; II.1, Ciomadu volcano; II.2, Persani perimeter

Instruments and methodology

As previously mentioned, two geophysical methods targetting the potential fields of the Earth have been applied:

- ground magnetics
- gravimetry

The instruments and methodology has been the same as employed in the previous stage of the project.

A proton magnetometer Geometrics G856 AX (0.5 nT sensitivity) has been used for current field observations while a Scintrex SM 5 NAVMAG optical pump instrument (0.003 nT sensitivity) has been used for diurnal activity record.

Fig. 2 Total intensity scalar of the geomagnetic field observation within the Persani perimeter

Data points positioning was achieved by the help of a hand GARMIN 76S GPS receiver (± 2.5 m accuracy).

Gravity data were acquired by using the up to date Scintrex CG-5 gravity meter (1 µgal sesitivity).

Both magnetic and gravity works were conducted within an irregular network, mainly following the access ways (see Fig. 3 for an example).

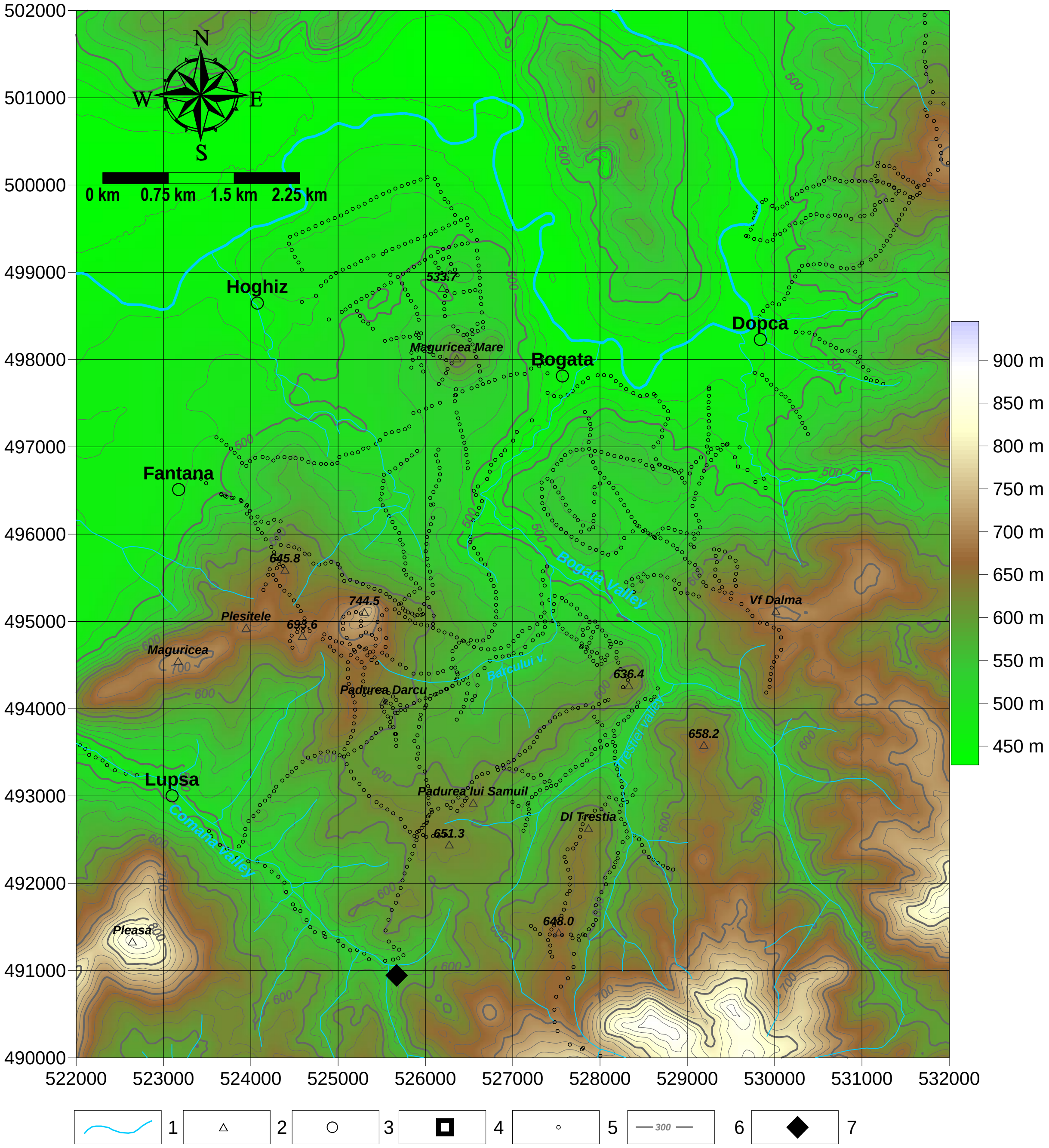


Fig. 3 Topography model and the network of geomagnetic observations within Persani area

Witin areas of rough topography (Călimani and Harghita Mountains), two main approaches were employed: (i) a regional survey for covering the studied region as a whole, in order to outlin the overal pattern of the gravity/geomagnetic field, and (ii) a more detailed investigation in the smaller areas of interest as revealed by reconnaisance.

Călimani area

Fig. 4 shows the topography of the north part of the region explored within the third stage: Călimani Mountains,

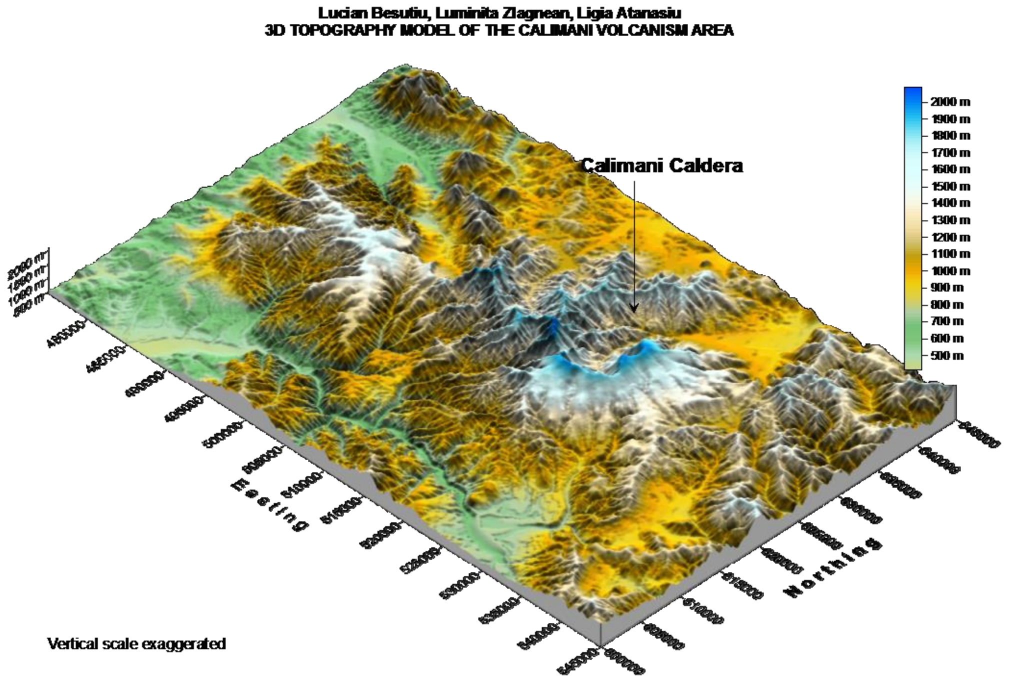


Fig. 4 3D topography model of the Călimani perimeter

The overall aspect of the geomagnetic field in the area is shown in Fig. 5.

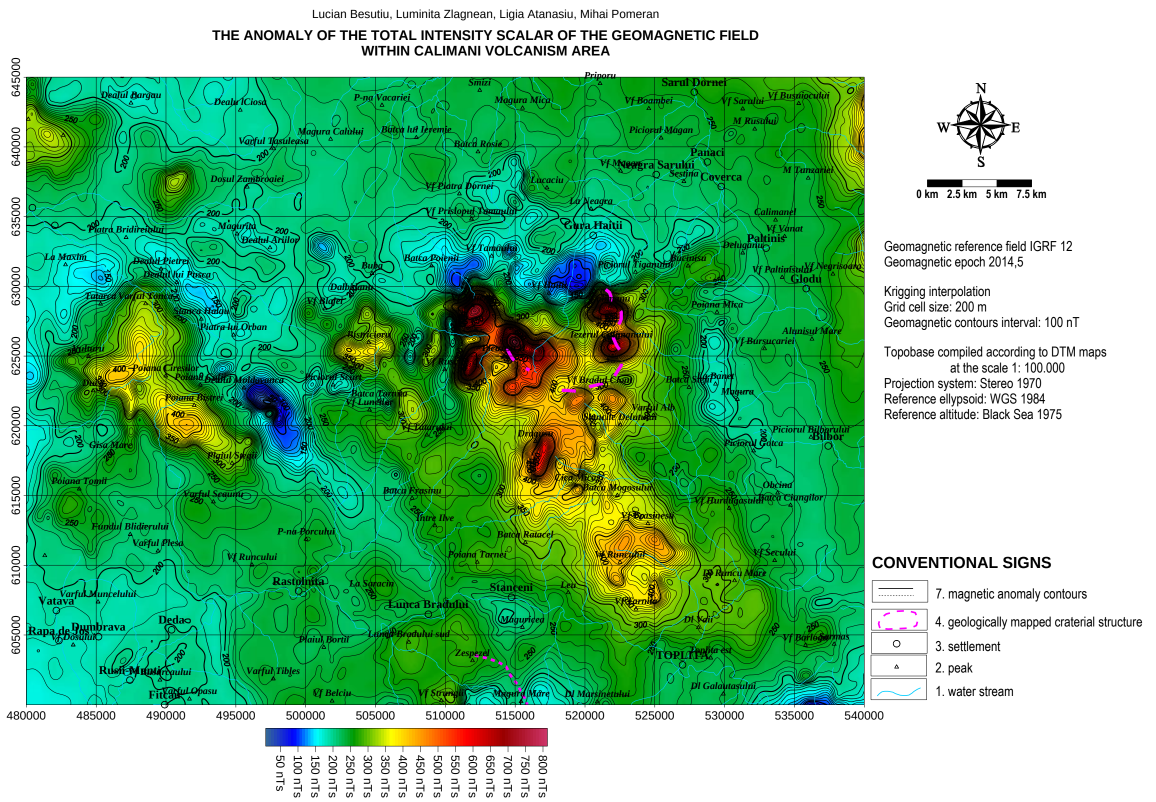


Fig. 5 The total intensity scalar geomagnetic anomaly within Călimani area on a plan located at 2500 m above the sea level

Similarly, a synoptic image of the Bouguer anomaly in the Călimani area has been constructed and is presented in Fig. 6.

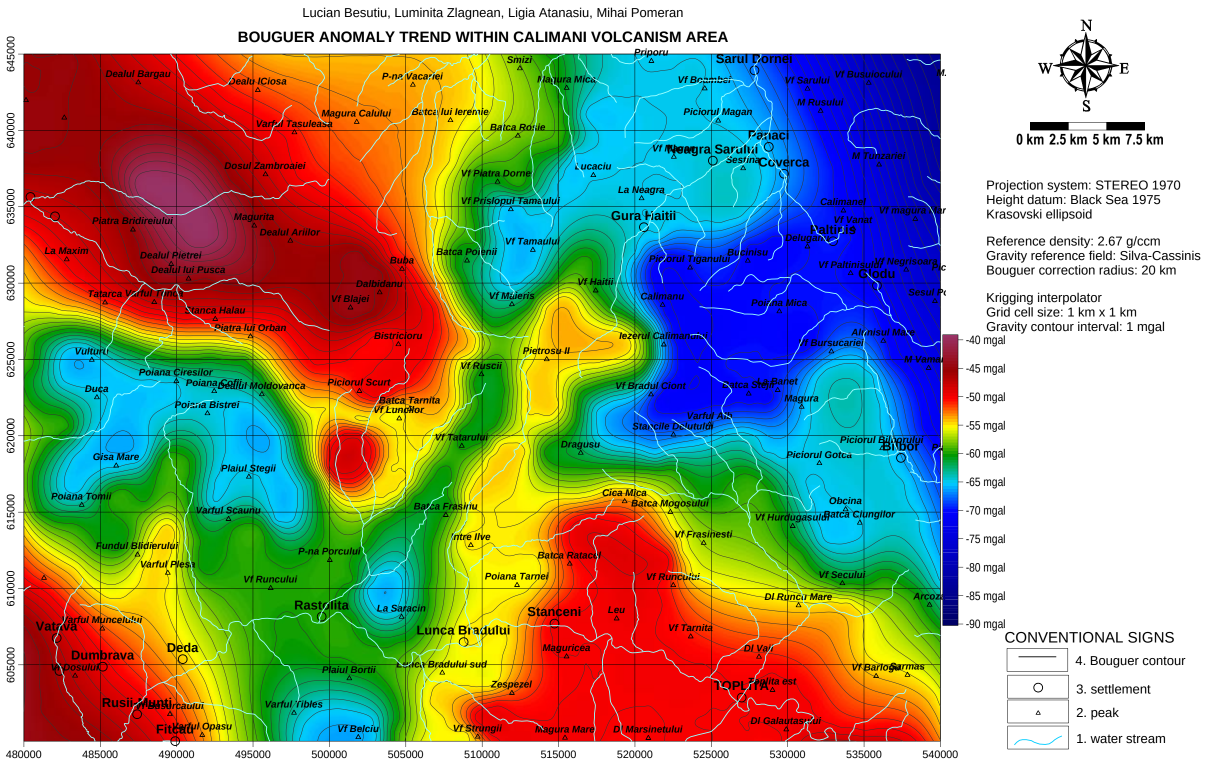


Fig. 6 Synoptic view of the Bouguer anomaly within Călimani area

The most important volcanic structure in the area is the Călimani caldera (for location see Fig. 4). A topography model is shown in Fig. 7. The image is presented from two perspectives.

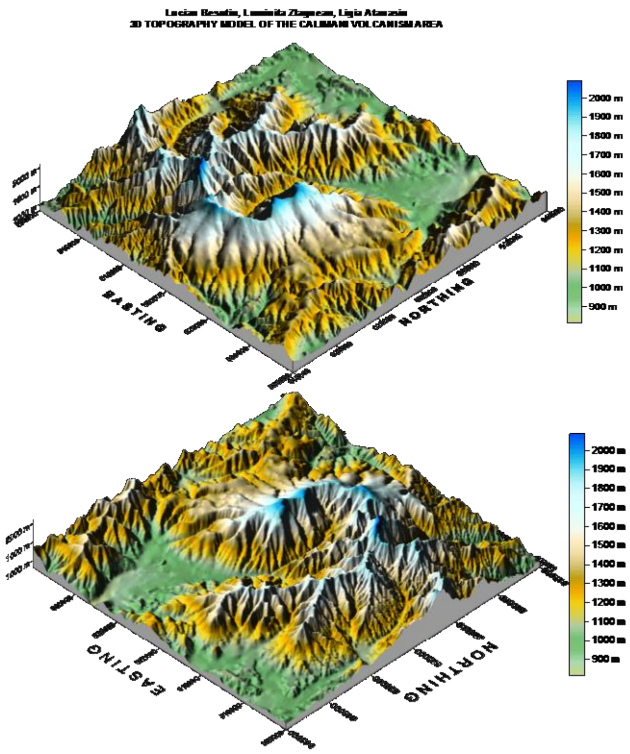


Fig. 7 North-Westward and South-Eastward 3D views on the Călimani caldera topograpy

Some more detailed gravity and geomagnetic surveys have revealed the pattern of the Bouguer and geomagnetic anomaly in the area (Fig. 8 - 9).

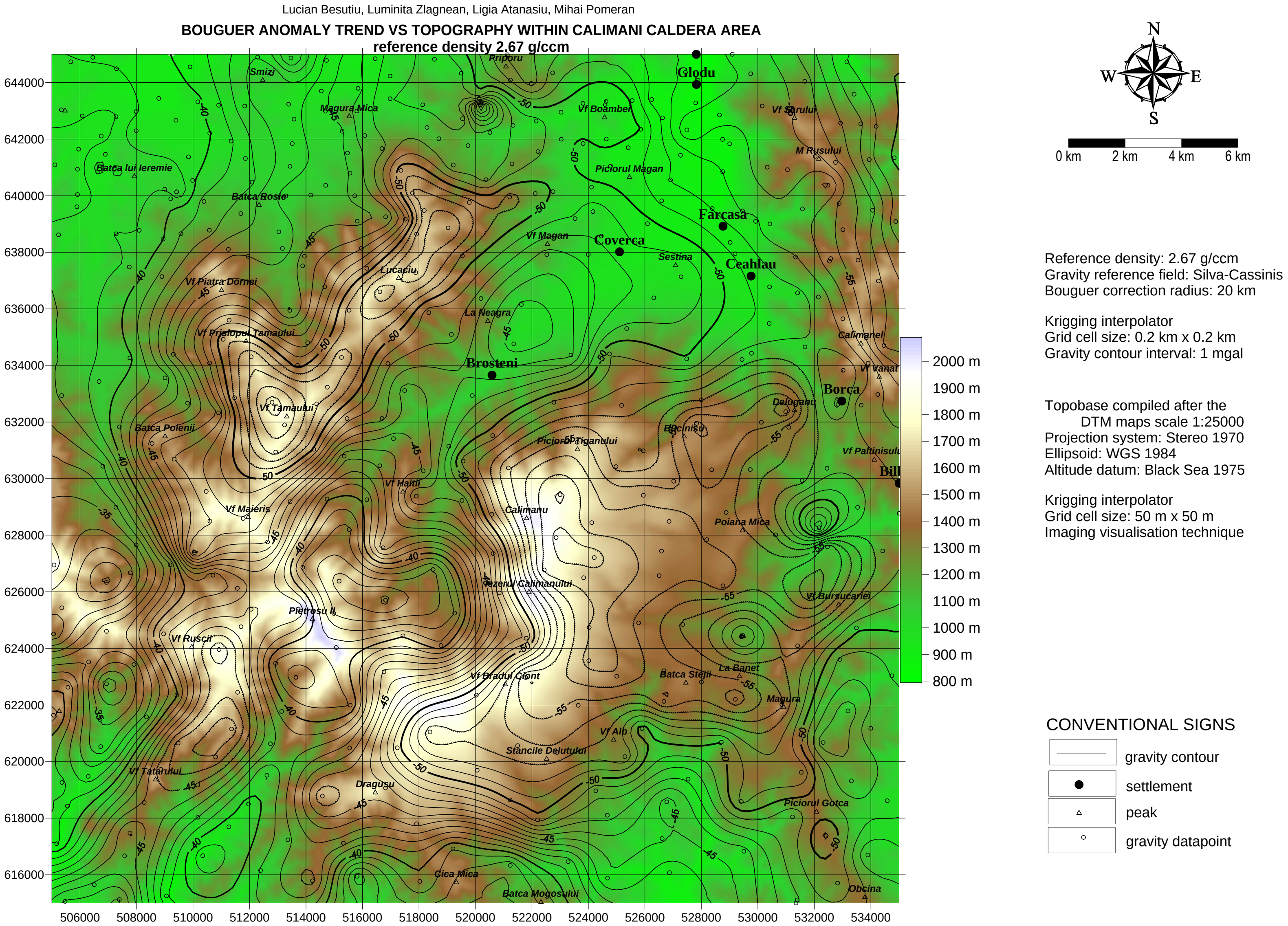


Fig. 8 Bouguer anomaly versus the topography model for Călimani caldera

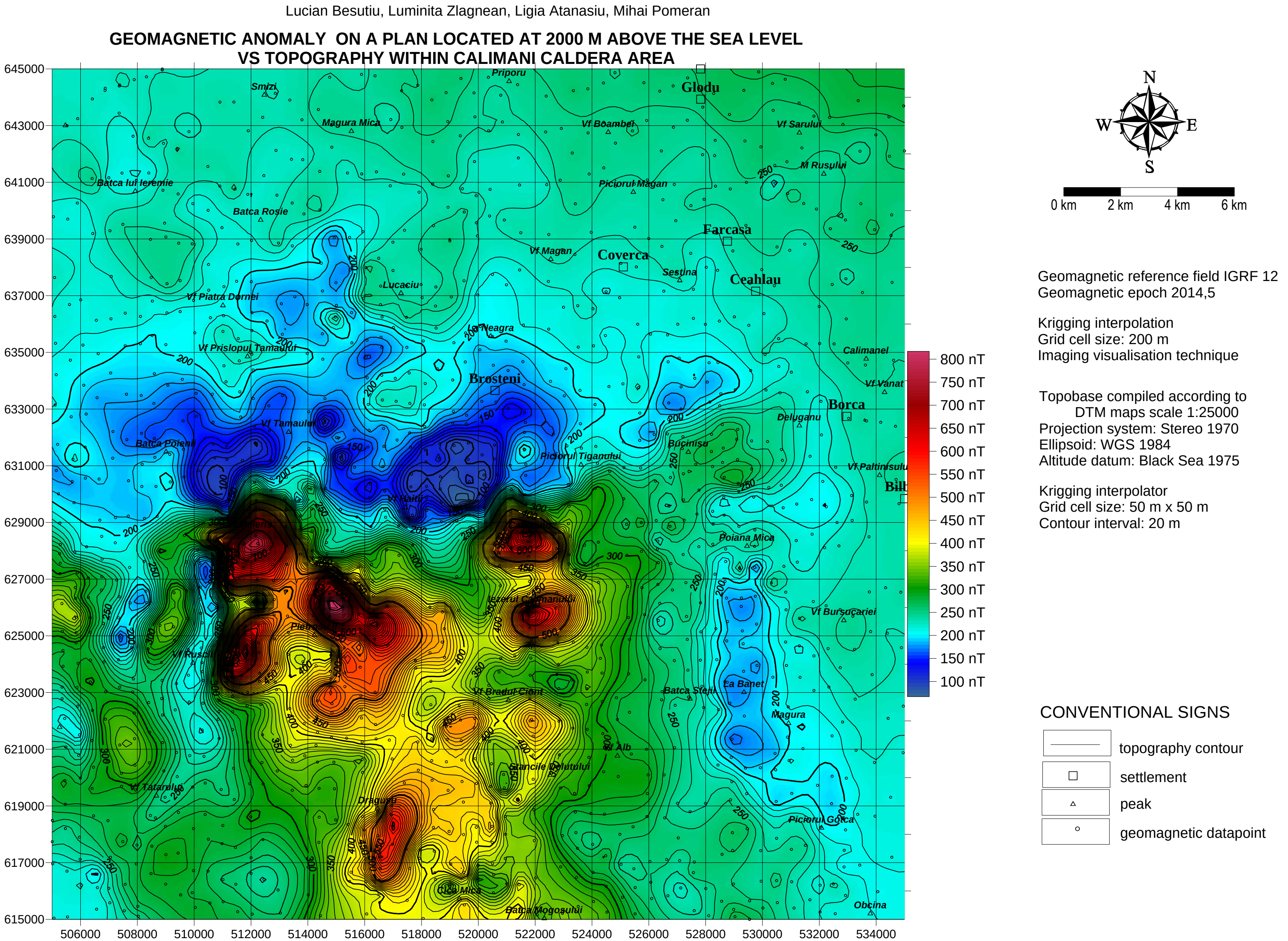


Fig. 9 Total intensity scalar geomagnetic anomaly on a plan located at 2500 m above the sea level for Călimani caldera

Harghita area

The next studied area was the Harghita Mountains. As in the case of the Călimani Mountains, the two above-mentioned survey approaches (regional and more detailed) have been applied. The gravity and geomagnetic investigations focussed on the main volcanic structures as known in the area: Luci-Lazu, Cucu and Pilişca.

The topography of the area is shown on the Fig. 10 along with location of the main volcanic structures.

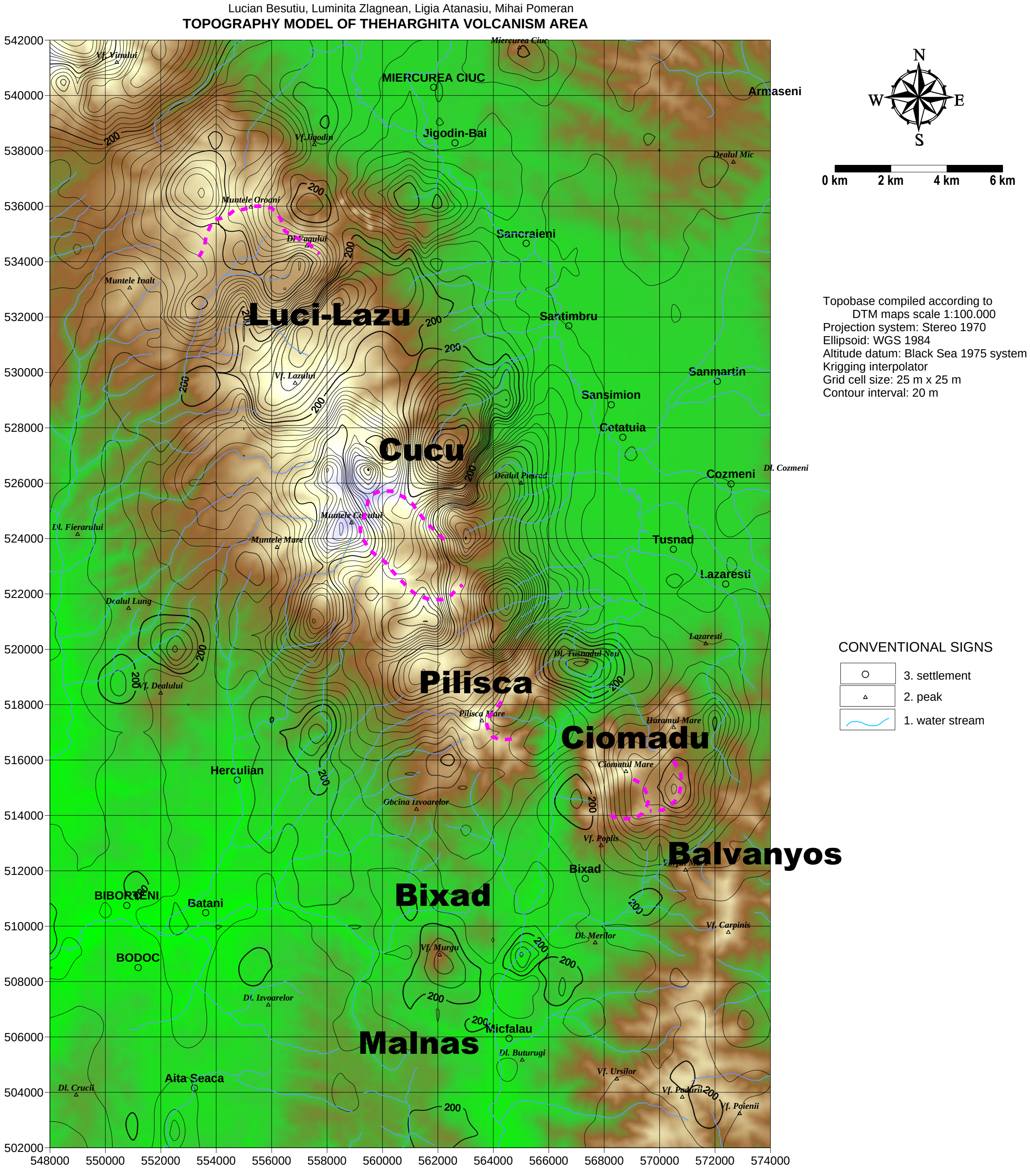


Fig. 10 Topography model of the Harghita volcanism area

Fig. 11 presents a synoptic image on the pattern of the geomagnetic anomaly over the whole area of Harghita Mountains and surrounding region.

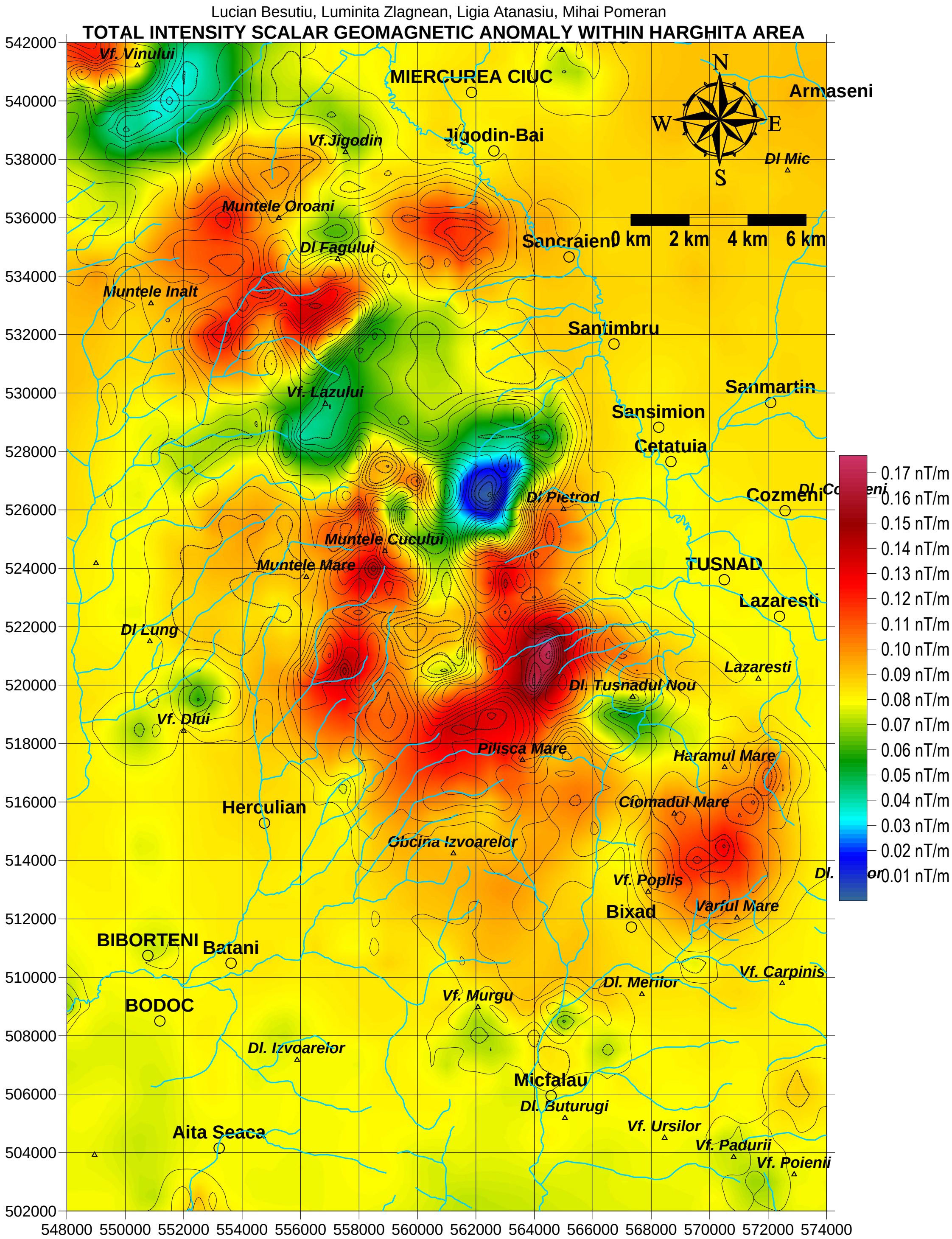


Fig. 10 Synoptic view of the geomagnetic anomaly within Harghita volcanism area

The Bouguer anomaly trend within the Harghita volcanism area is presented in the Fig. 11.

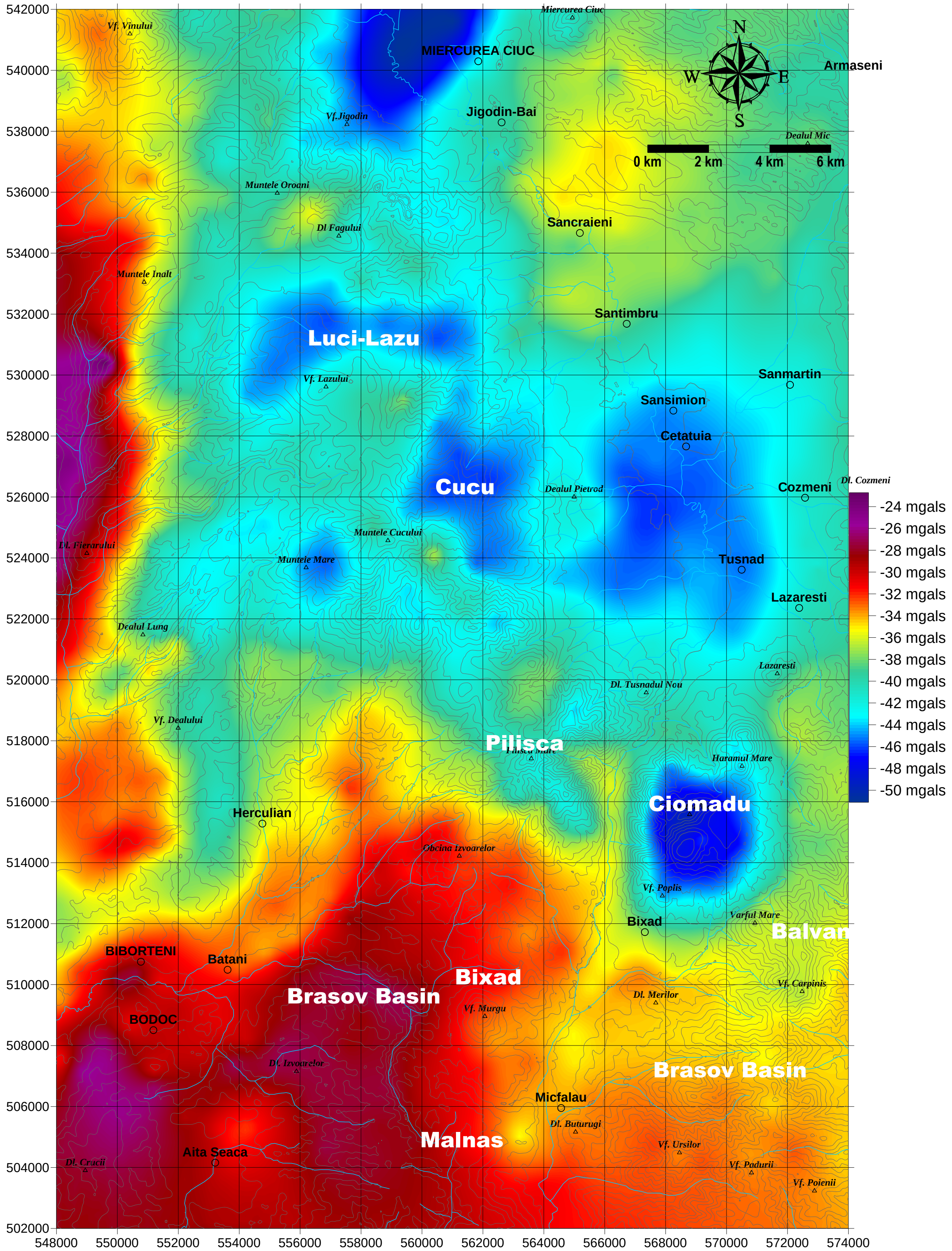


Fig. 11 Bouguer anomaly trend within Harghita volcanism area versus topography
Reference density: 2.67 g/ccm

Some more detailed images on the gravity and geomagnetic field within the area of Cucu volcano are shown in figures 12 and 13.

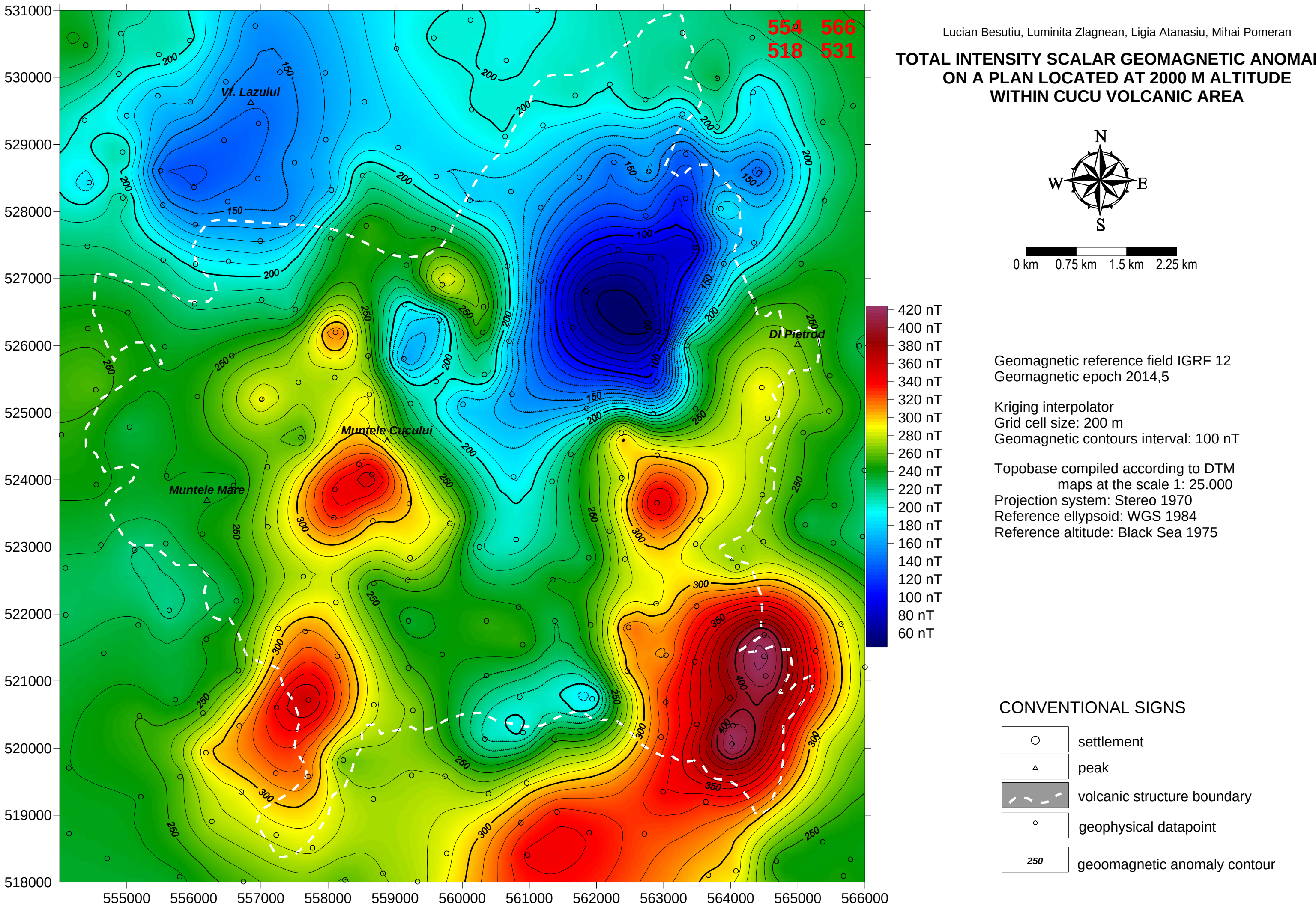


Fig. 12 Total intensity scalar geomagnetic anomaly within Cucu volcano area

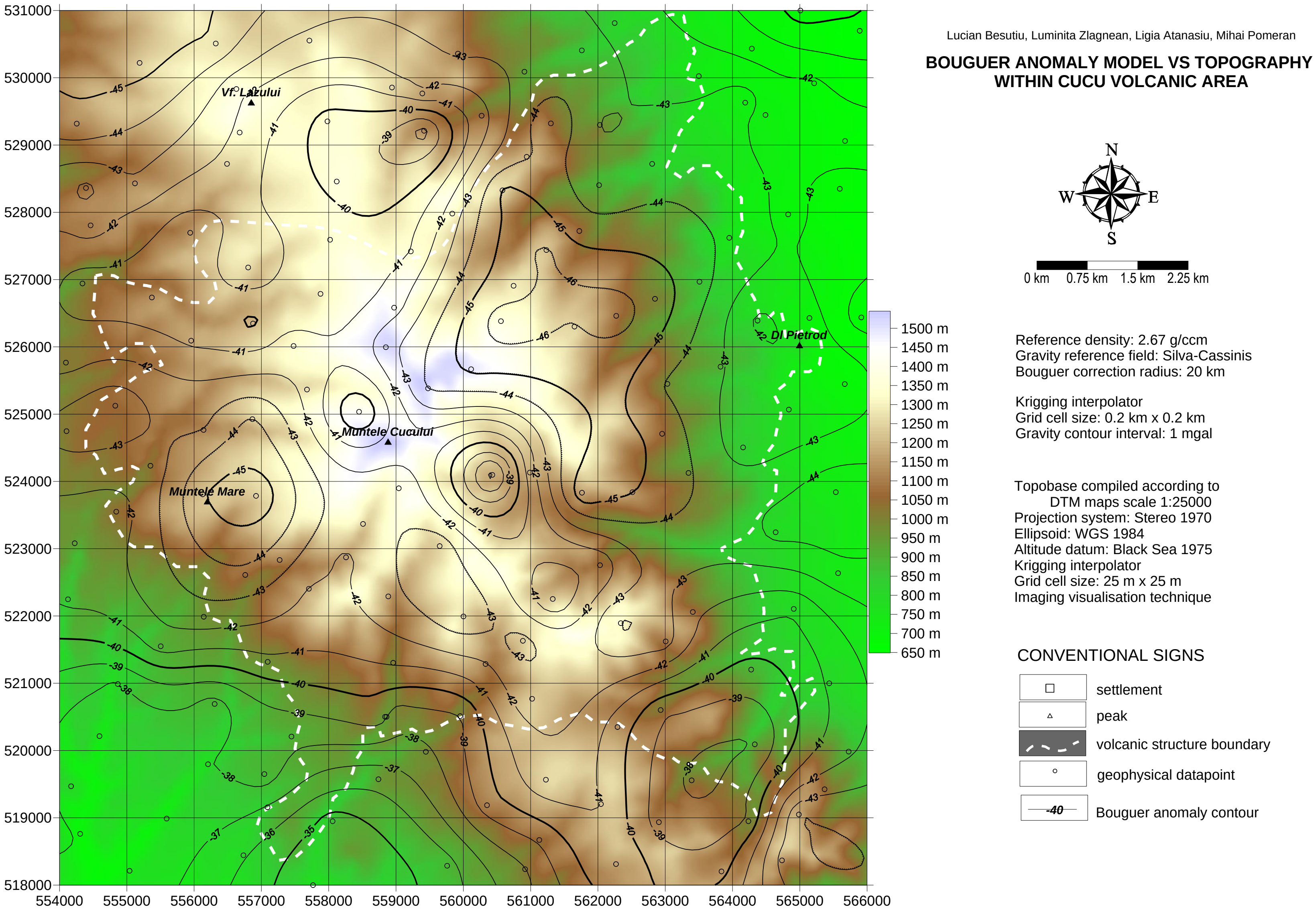


Fig. 13 The Bouguer anomaly versus topography within Cucu volcano area. Reference density 2.67 g/ccm

Persani area

In the southernmost part of the Calimani-Gurghiu-Harghita volcanism area, the Perşani Mountains, geomagnetic observations started in the previous stage of the project has been continued for extending the surveywd area and improving the overall coverage. The new image of the geomagnetic field in the area is shown in Fig.14.

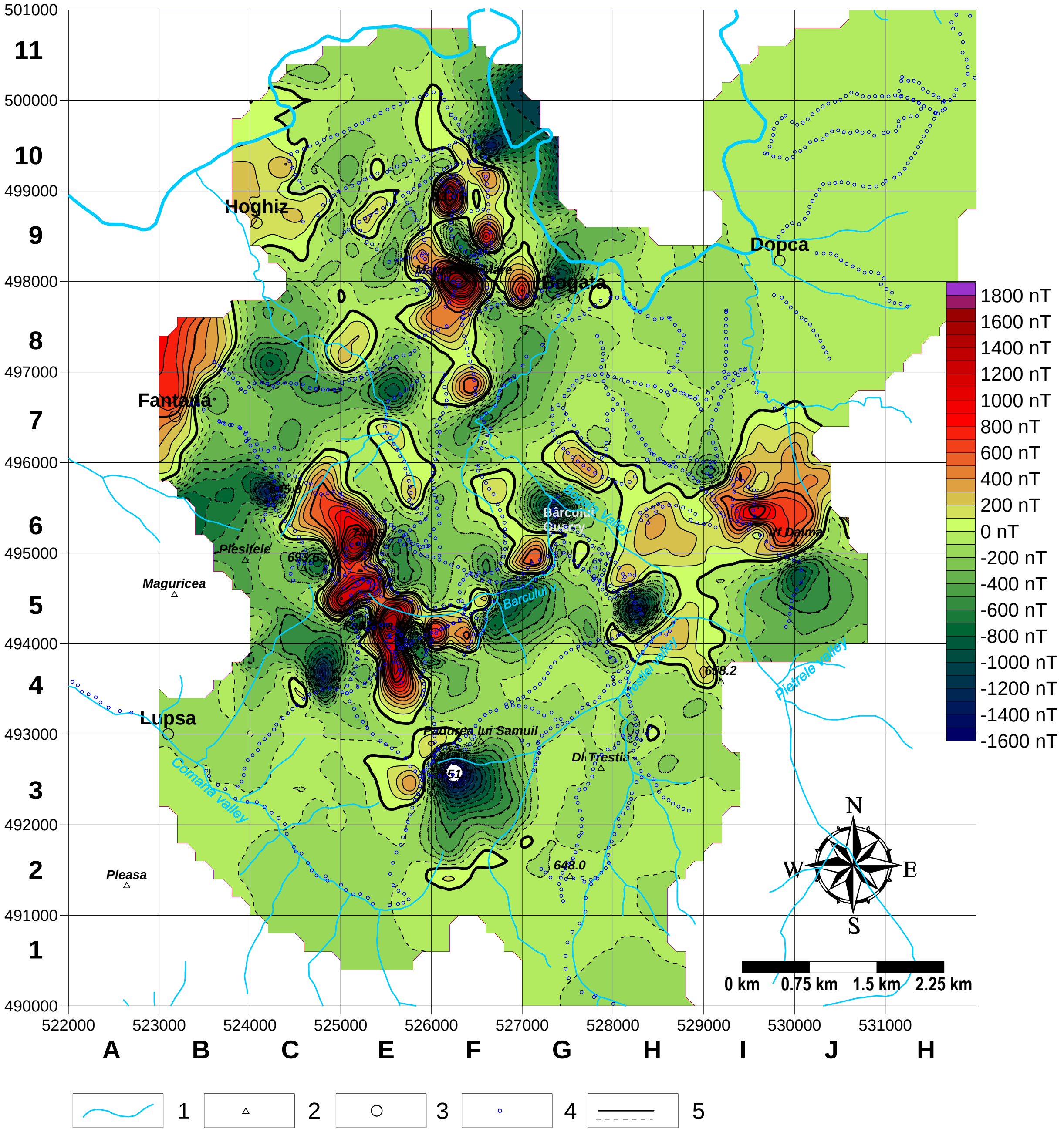


Fig. 14 Total intensity scalar geomagnetic anomaly within the Perşani volcanism area
1, water stream; 2, peak; 3, settlement; 4, data point; 5, isoanomal contour

3.2.1. **GEOPHYSICAL DATA PROCESSING**

The next step in the geophysical investigations was data processing. In order to easy the geological interpretation, the geophysical data were processed in an advanced manner for providing more intuitive images, helping the interpreter to link them to their geological backghround. Among the approaches employed it is worth mentioning *upward/downward continuations,vertical gradient,horizontal gradient. reduction to the pole of geomagnetuic data,pseudo-gravity. apparent susceptibility*.The following figures provide some examples.

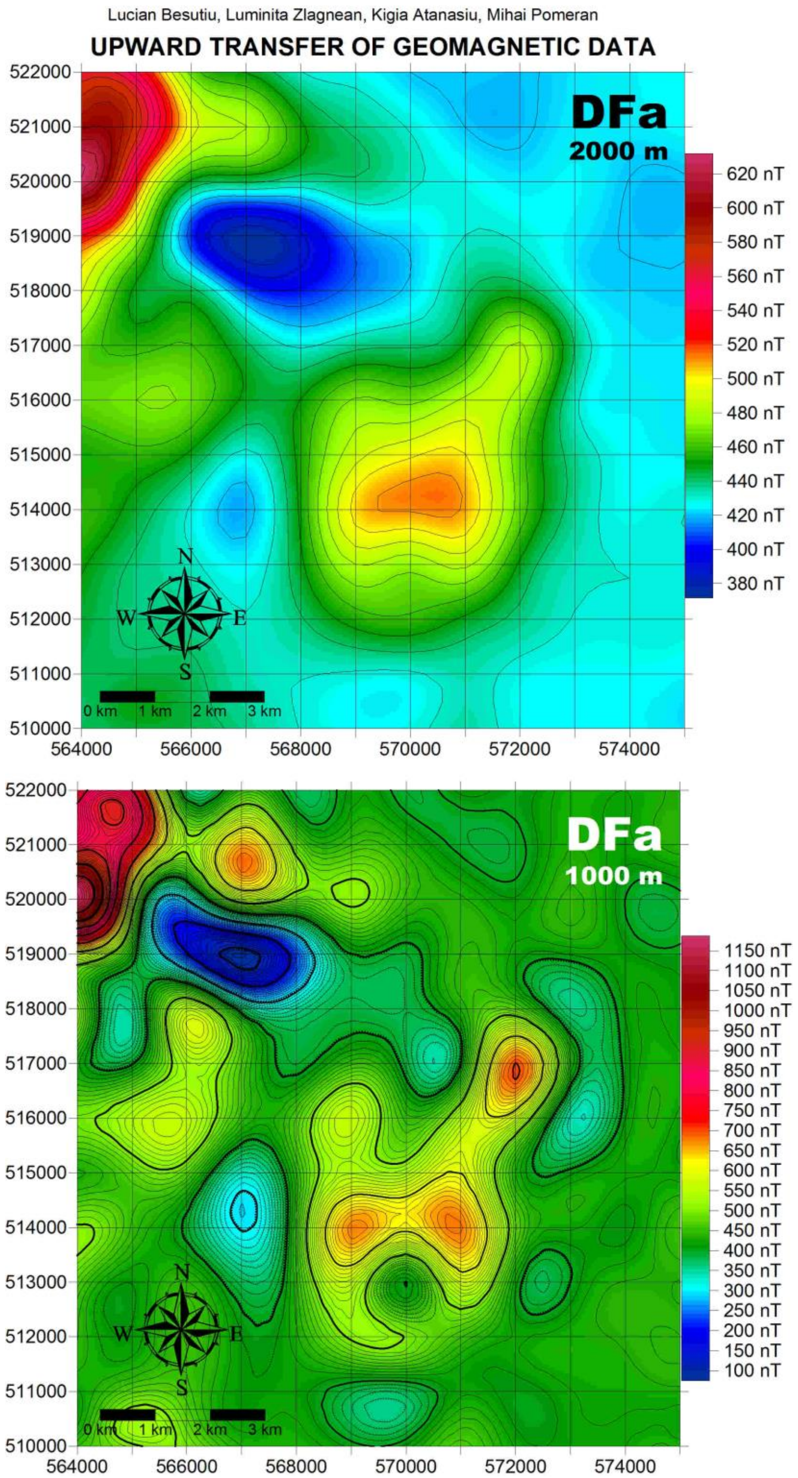


Fig. 15 Upward transfer of geomagnetic anomaly from 1000 m to 2000 m above the sea level within Ciomadu volcano area

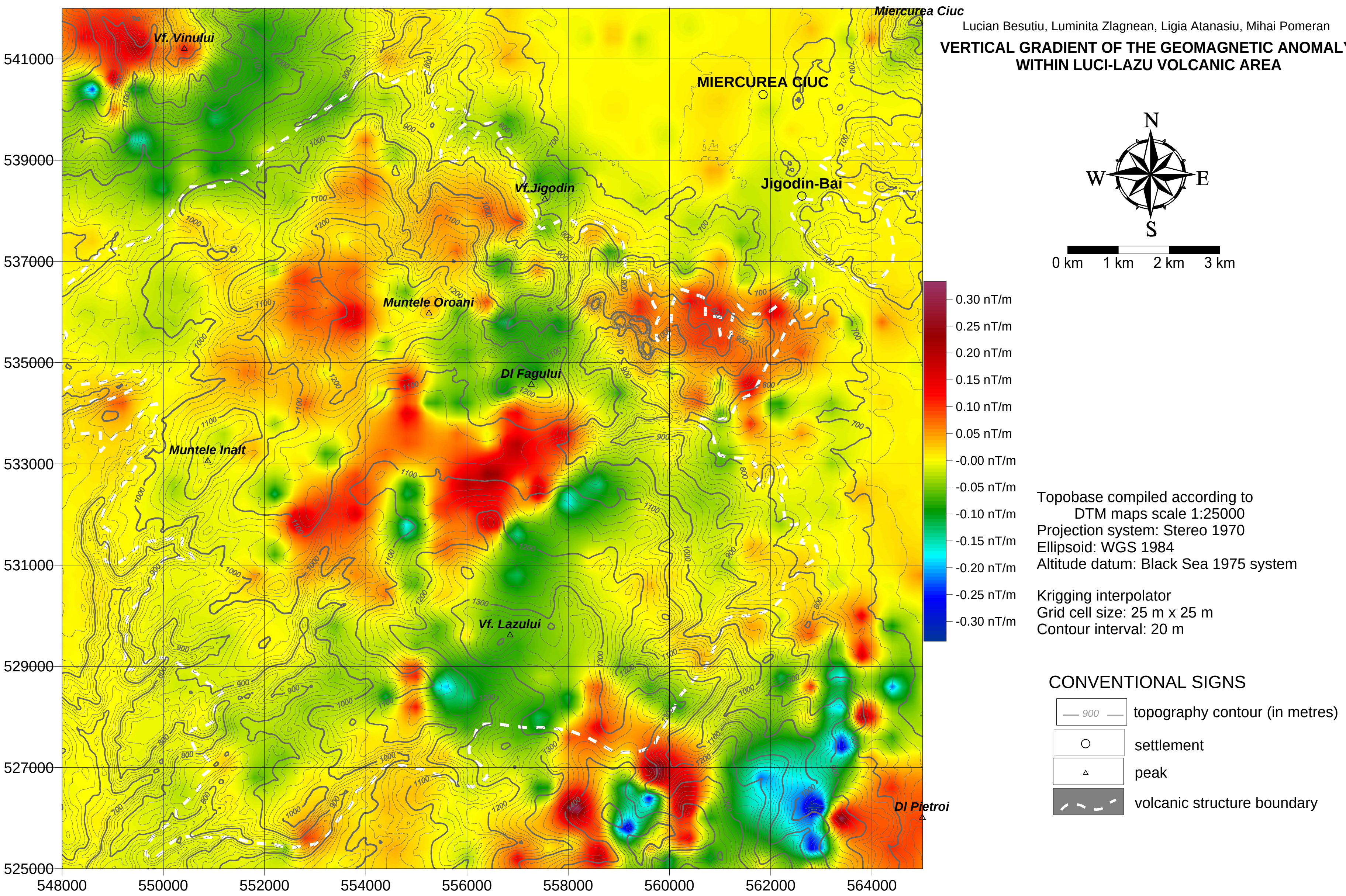


Fig. 16 Vertical gradient of the geomagnetic anomaly versus topography within Luci-Lazu volcanism area

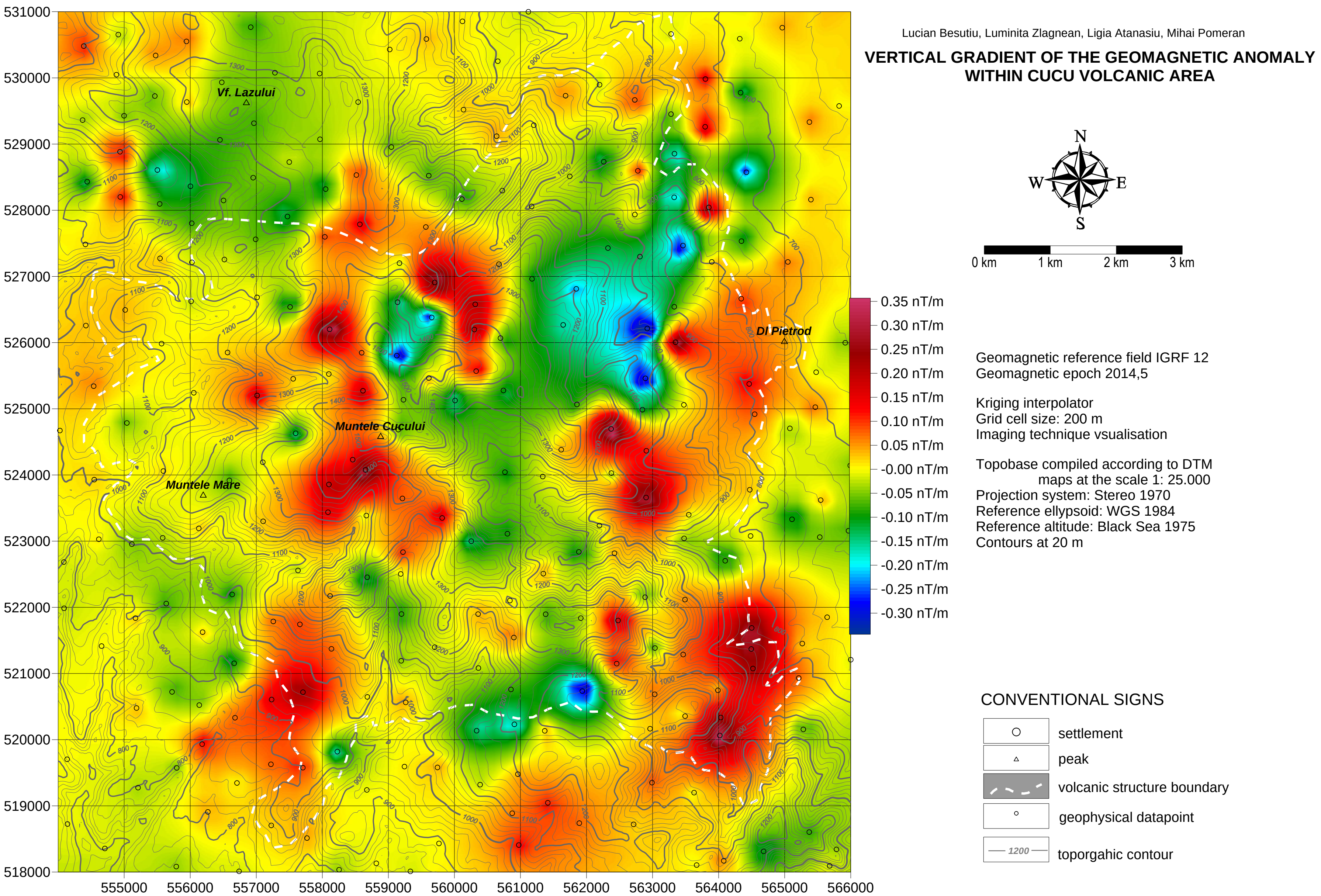


Fig. 17 Vertical gradient of the geomagnetic anomaly versus topography within Cucu volcano area

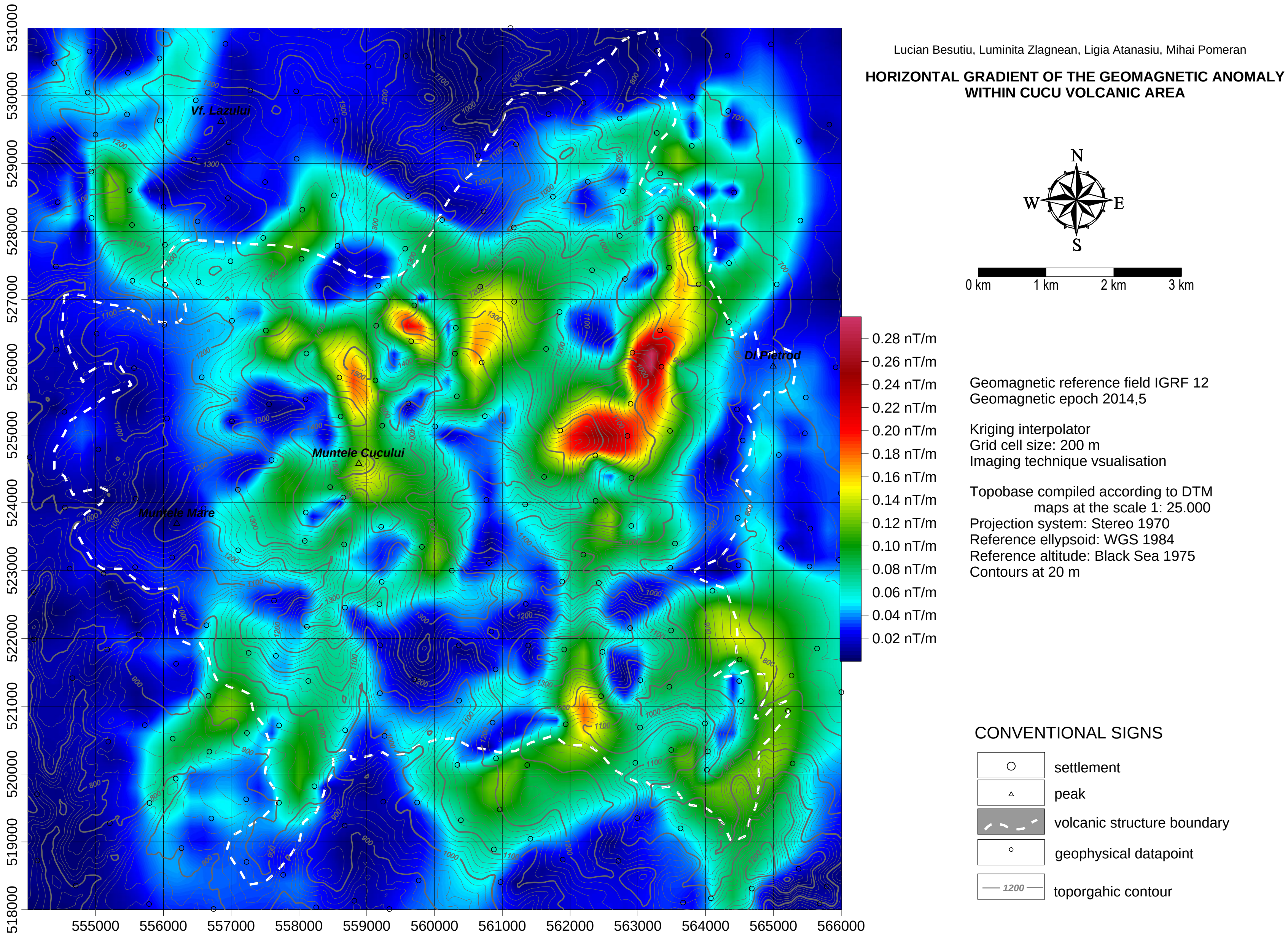
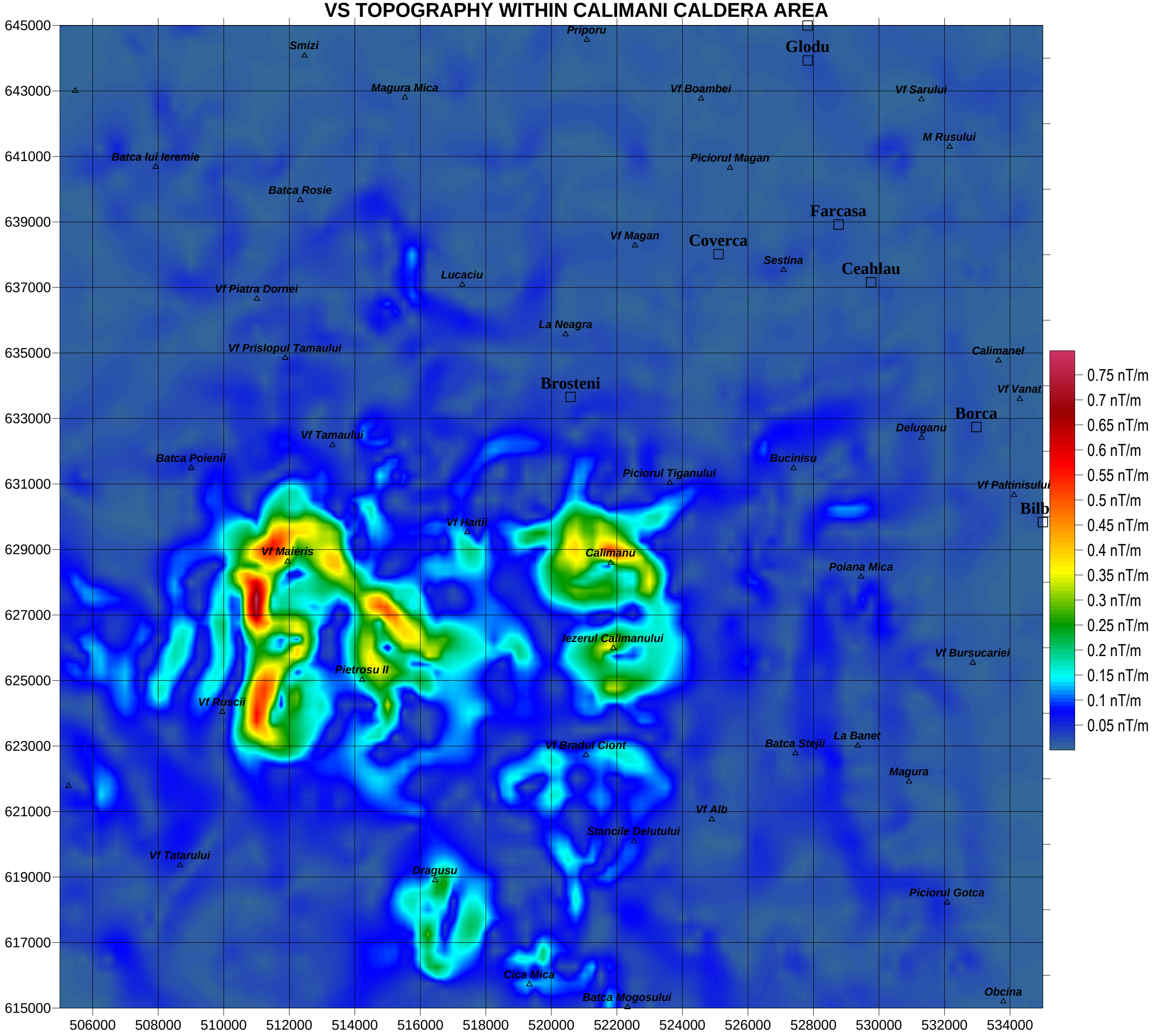
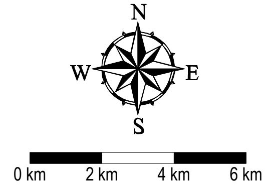


Fig. 18 Horizontal gradient of the geomagnetic anomaly versus topography within Cucu volcano area

Lucian Besutiu, Luminita Zlagnean, Ligia Atanasiu, Mihai Pomeran

HORIZONTAL GRADIENT OF GEOMAGNETIC ANOMALY ON A PLAN LOCATED AT 2000 M ABOVE THE SEA LEVEL VS TOPOGRAPHY WITHIN CALIMANI CALDERA AREA





Geomagnetic reference field IGRF 12
Geomagnetic epoch 2014,5

Krigging interpolation
Grid cell size: 200 m
Imaging visualisation technique

Topobase compiled according to
DTM maps scale 1:25000
Projection system: Stereo 1970
Ellipsoid: WGS 1984
Altitude datum: Black Sea 1975

CONVENTIONAL SIGNS

- topography contour
- settlement
- peak
- geomagnetic datapoint

Fig. 19 Horizontal gradient of the geomagnetic anomaly within Călimani caldera area

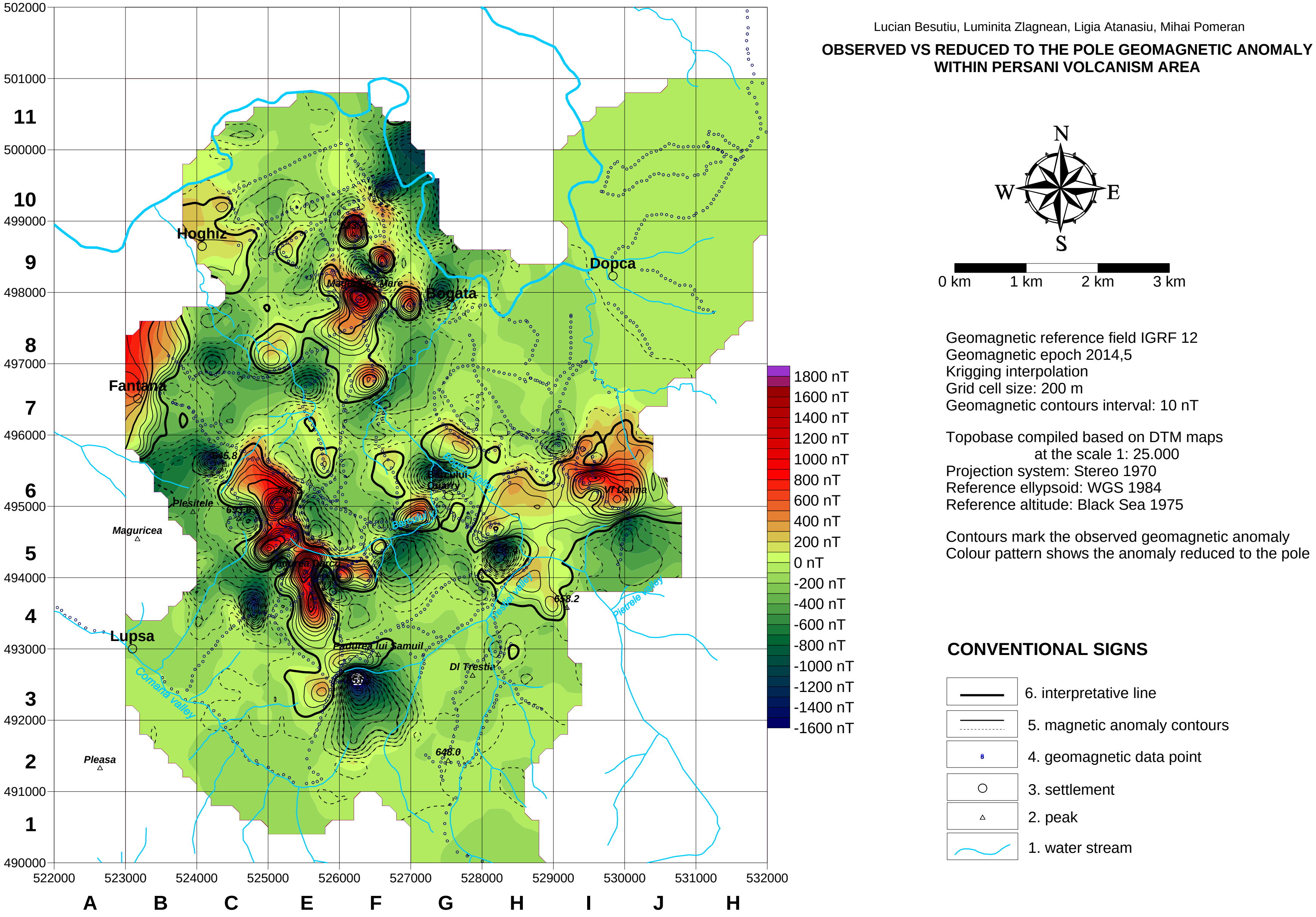


Fig. 20 Observed (contours) versus reduced to the pole geomagnetic anomaly (colours) within Perşani volcanism area

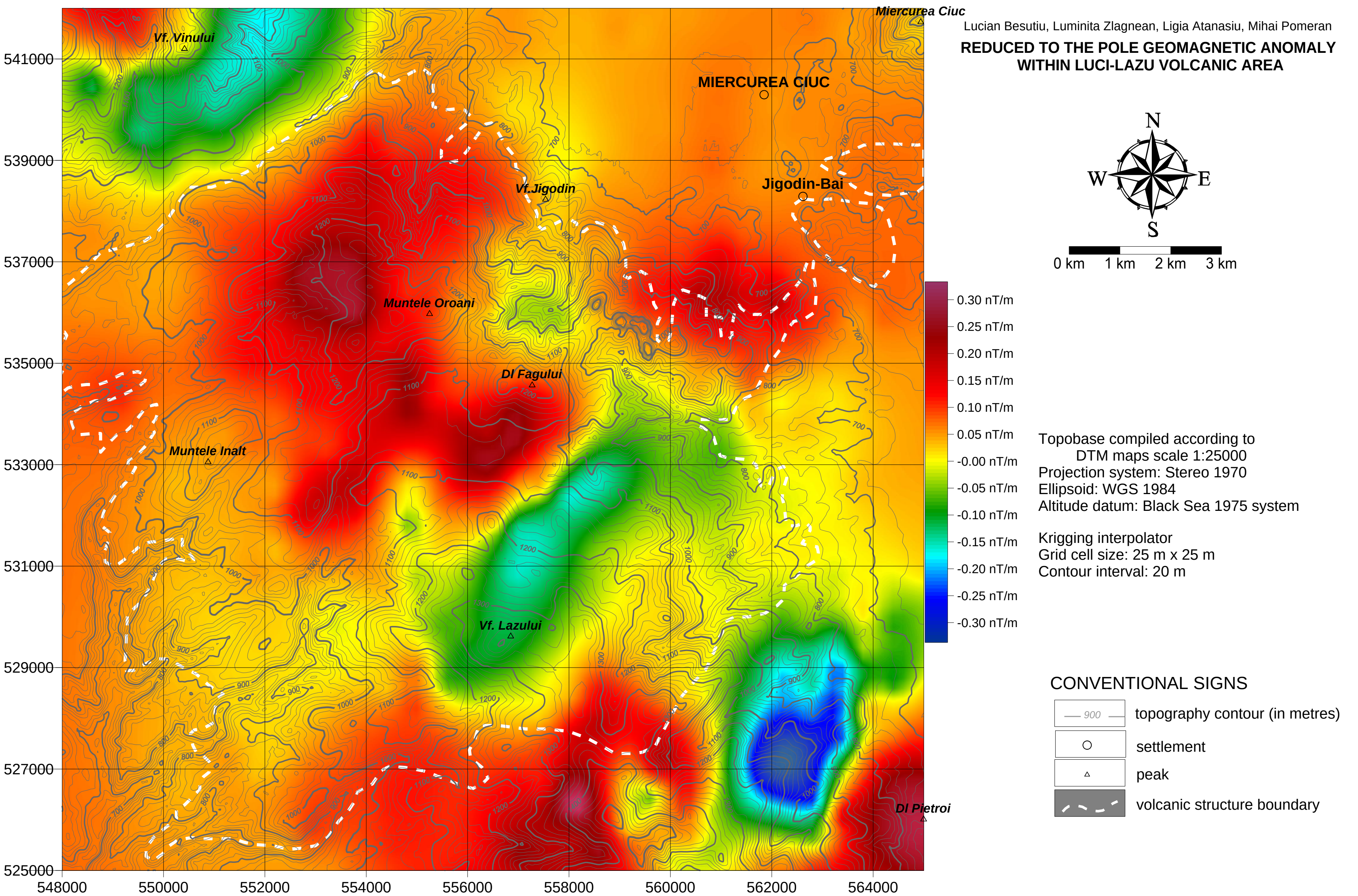


Fig. 21 Reduced to the pole geomagnetic anomaly versus topography within Luci-Lazu volcanism area

Lucian Besutiu, Luminita Zlagnean, Ligia Atanasiu, Mihai Pomeran

PSEUDO-GRAVITY ANOMALY ON A PLAN LOCATED AT 2000 M ABOVE THE SEA LEVEL WITHIN CALIMANI CALDERA AREA

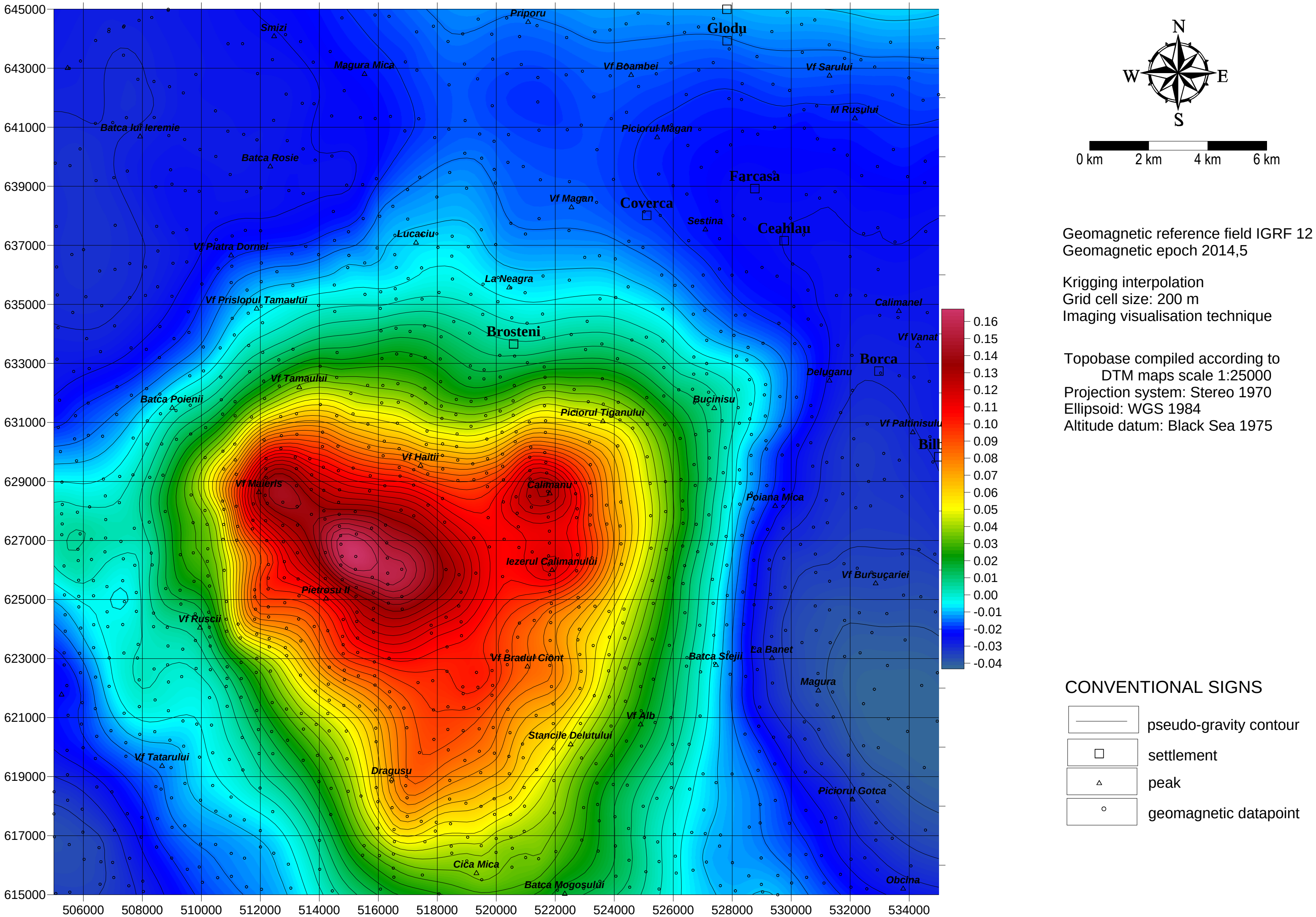


Fig. 22 Anomaly of the pseudo-gravity within Călimani caldera area

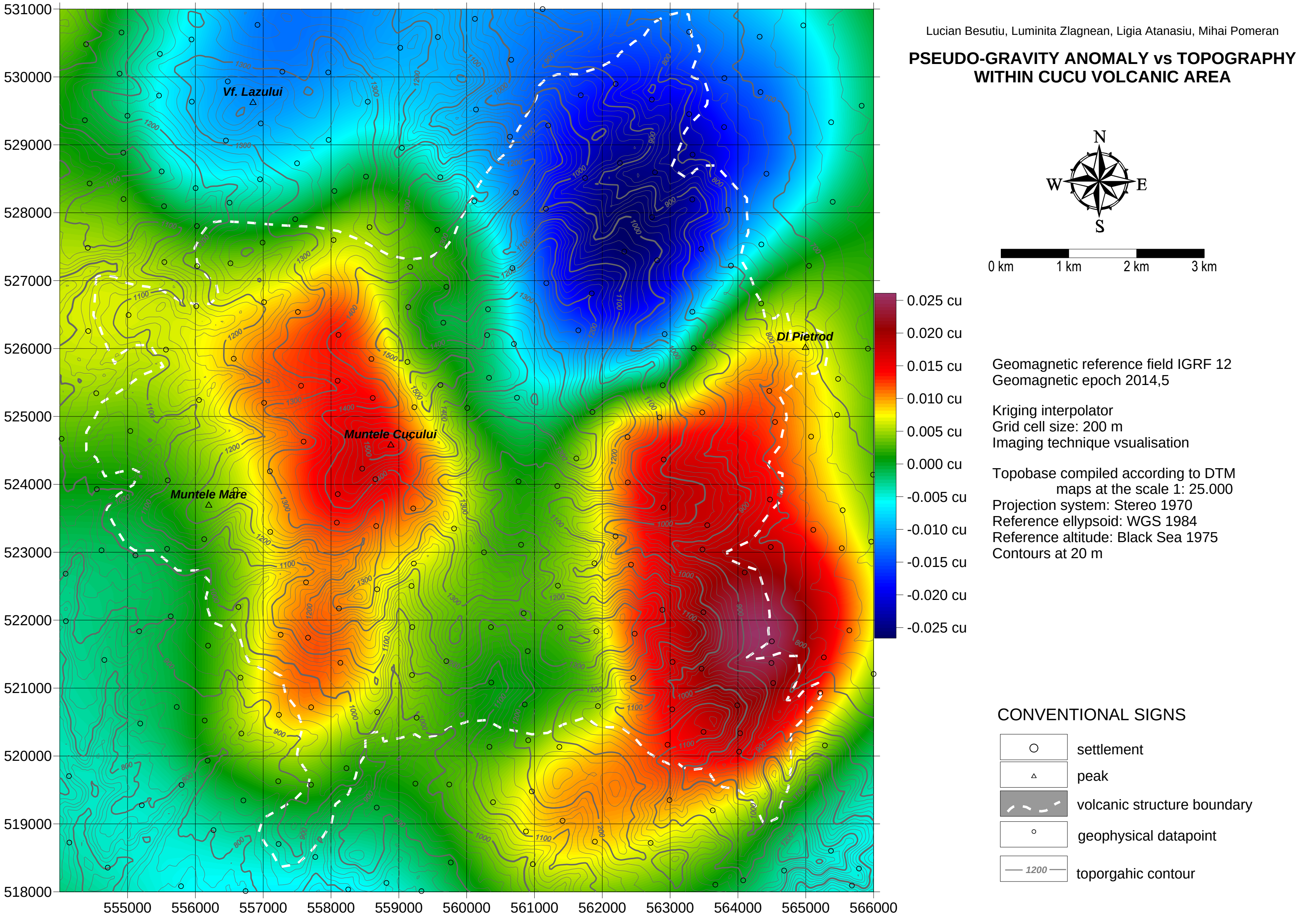


Fig. 23 Anomaly of the pseudo-gravity versus topography within Cucu volcano area

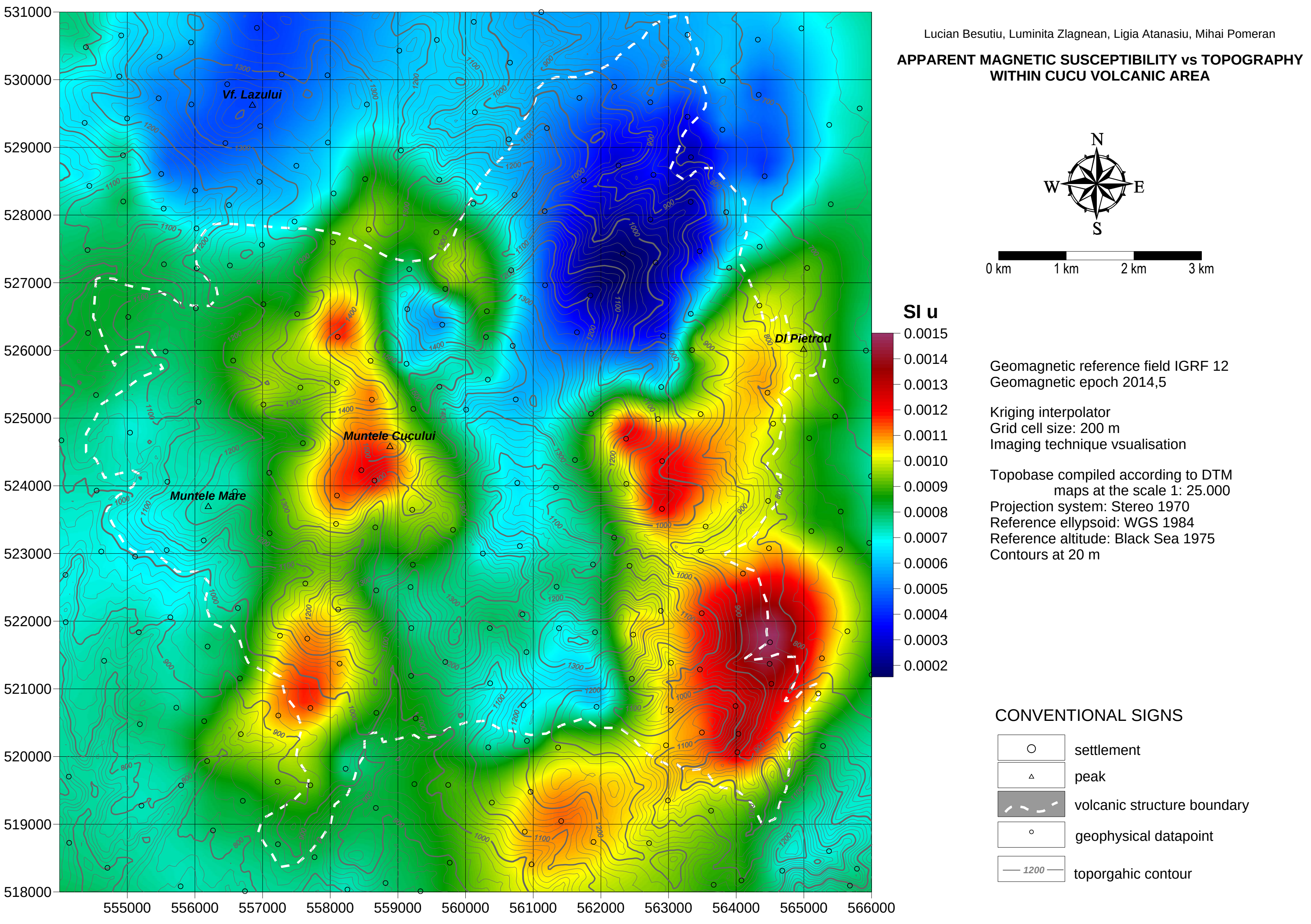


Fig. 24 Apparent susceptibility versus topography within Cucu volcano area

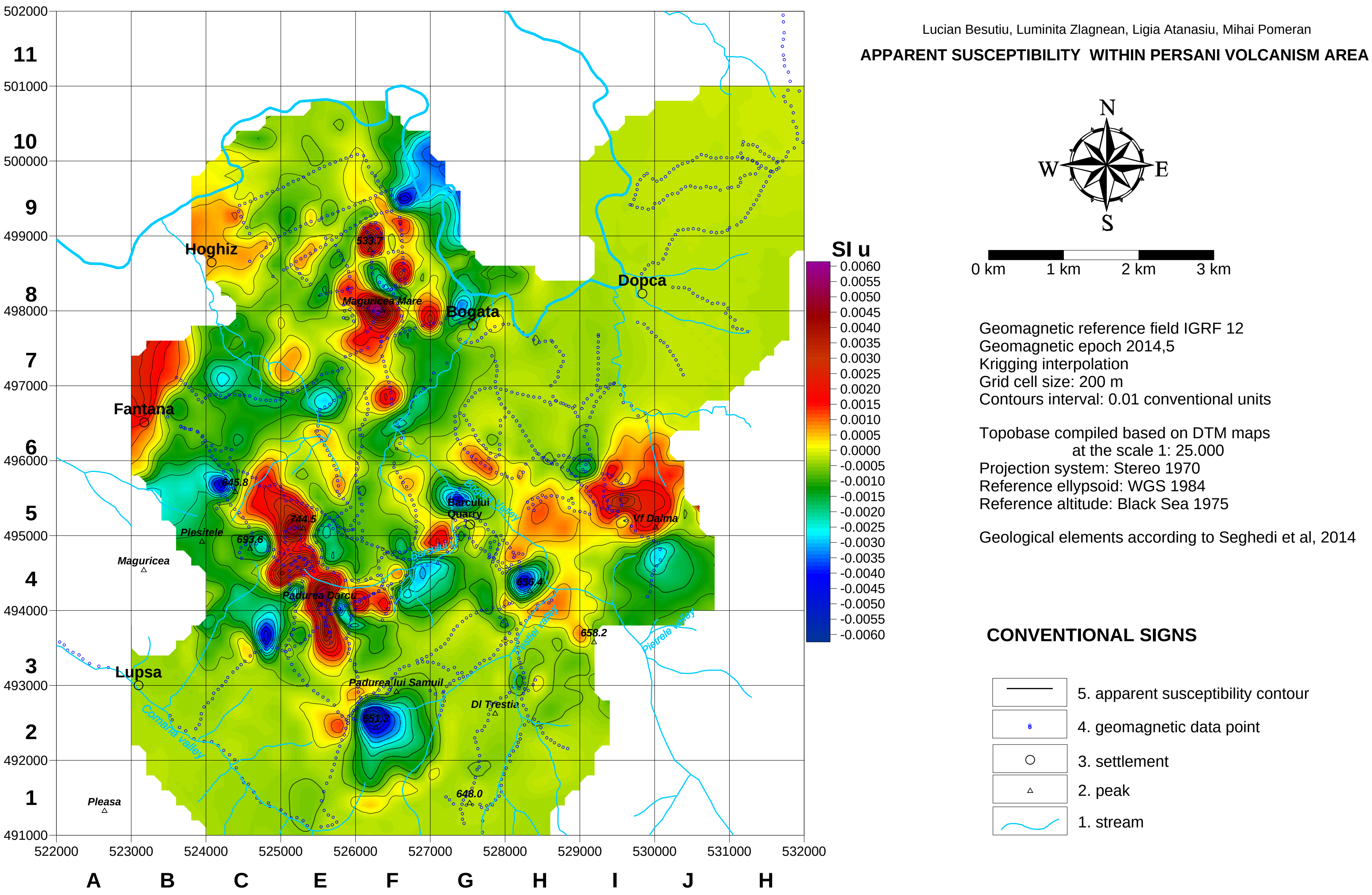


Fig. 25 Apparent susceptibility within Persani volcanism area

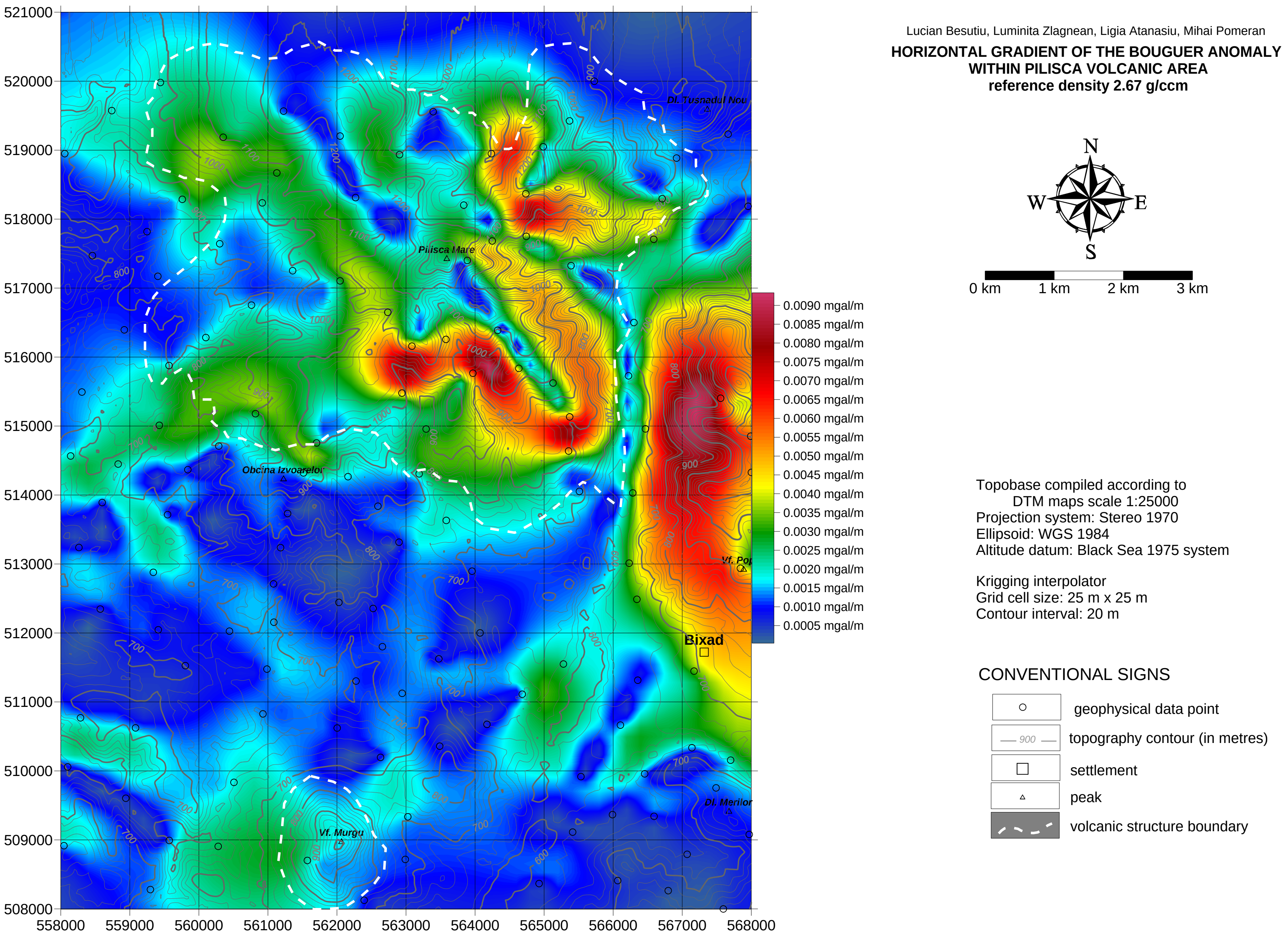


Fig. 26 Horizontal gradient of the Bouguer anomaly (reference density 2.67 g/ccm) and topography within Pilişca volcanism area

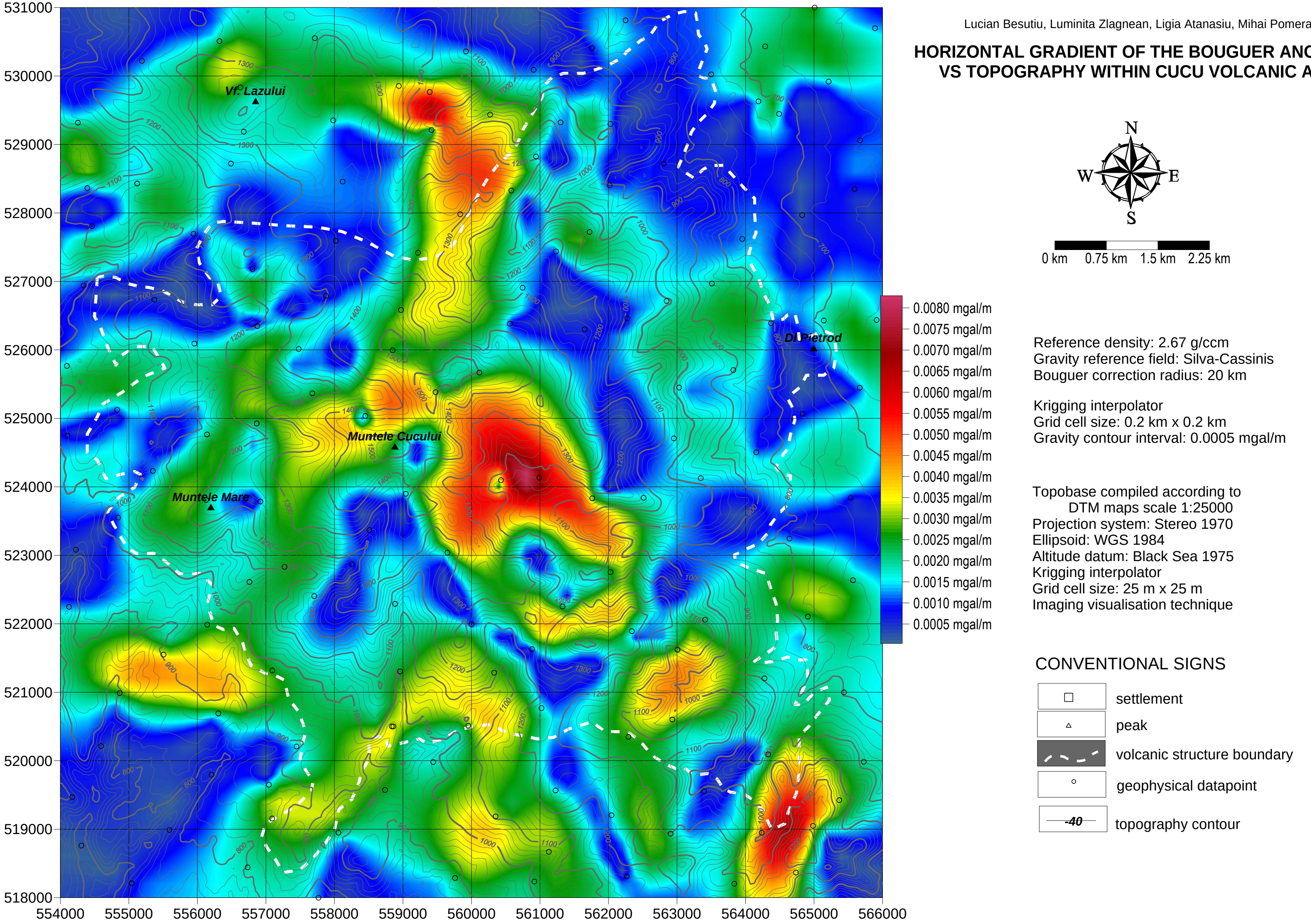


Fig. 27 Horizontal gradient of the Bouguer anomaly (reference density 2.67 g/ccm) and topography within Cucu volcanism area

GEOPHYSICAL DATA MODELLING

To help advancing knowledge on the in-depth extent of the volcanic structures within the study areas, some attempts to construct geological models based on the quantitative interpretation of the geophysical data were conducted.

Basically, 2D modelling algorithms have been used along several interpretative lines located within the Perşani and Ciomadu areas. For Ciomadu volcano, preliminary 2D models have been constructed for preparing the implementation of a 3D approach.

The GM-SYS 2D software run on OASIS platform has been used for practical inplementation.

Perşani area

Within Perşani area, 2D models have been achieved based on the interpretation of geomagnetic data. Fig. 28 shows the location of the interpretative lines.

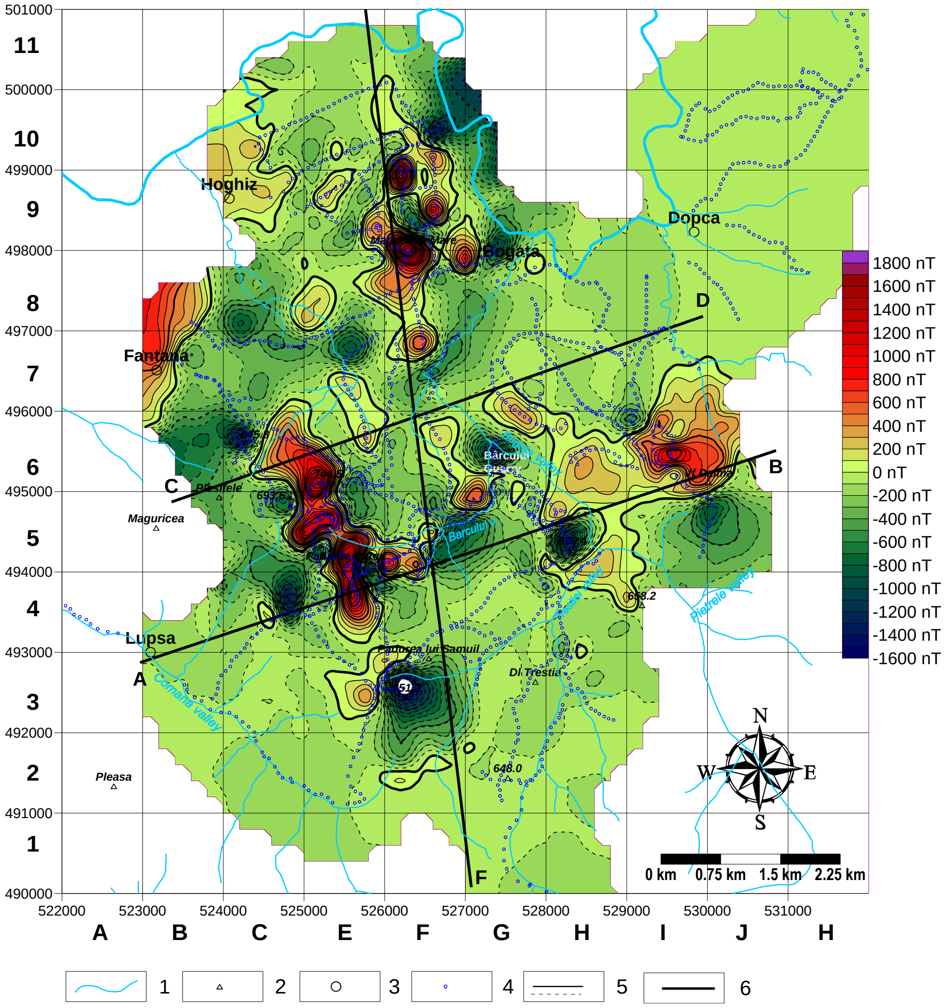


Fig. 28 The reduced-to-the-pole geomagnetic anomaly and location of interpretative lines within Persani area. 1, water stream; 2, peak; 3, settlement; 4, data point; 5, isoanomal; 6, interpretative line

Fig. 29 and 30 show the results obtained along the interpretative line CD, and EF.

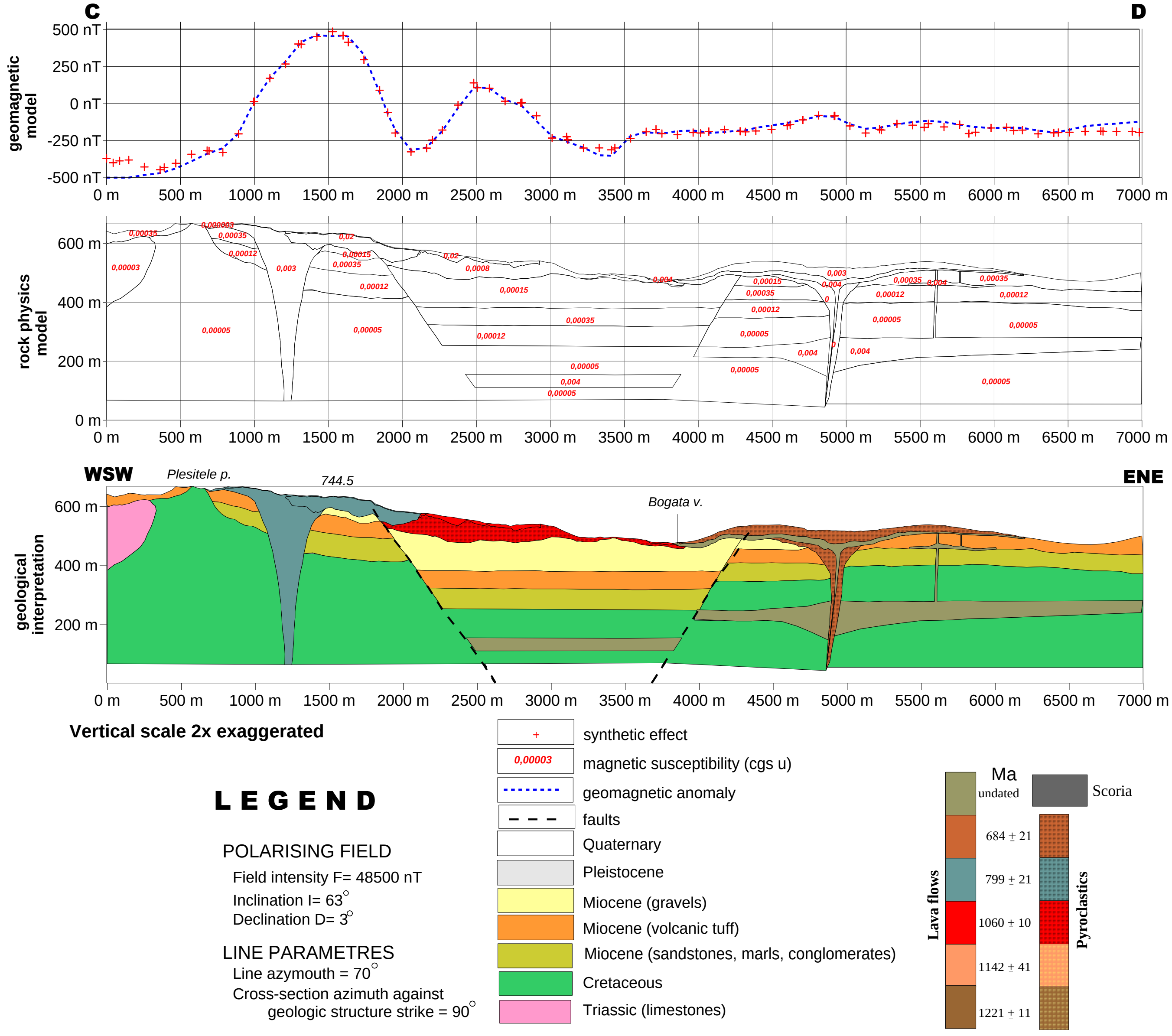


Fig. 29 2D modelling attempt within Perşani area along the CD line, based on the interpretation of geomagnetic data

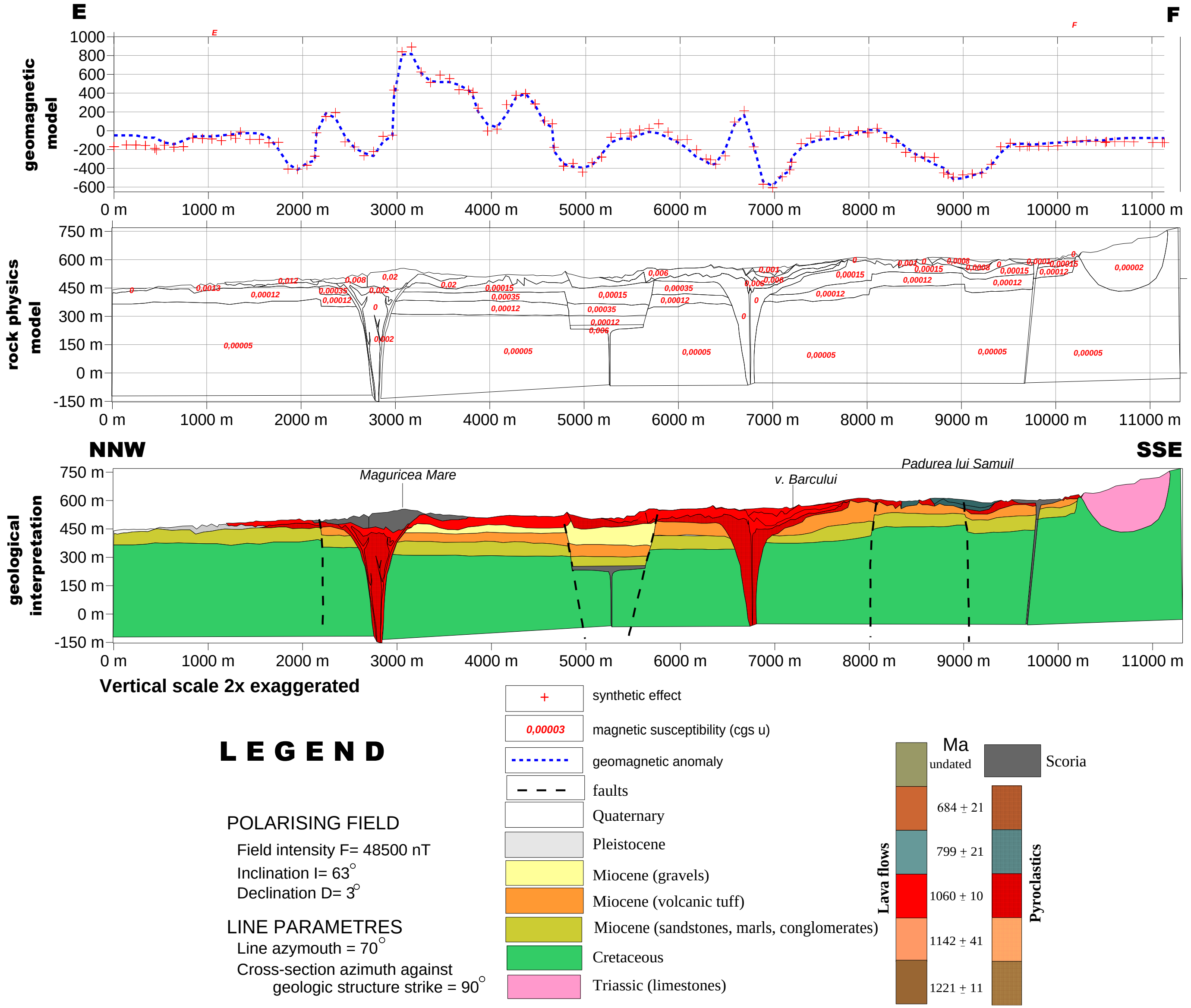


Fig. 30 2D modelling attempt within Perşani area along the EF line, based on the interpretation of geomagnetic data

Ciomadu volcano

In the attempt to construct a 3D model of the Ciomadu volcano structure, some preliminary 2D models were achieved at this stage, based on the integrated interpretation of the geomagnetic and gravity data, under the constraint of the rock physics information (Fig. 31-32).

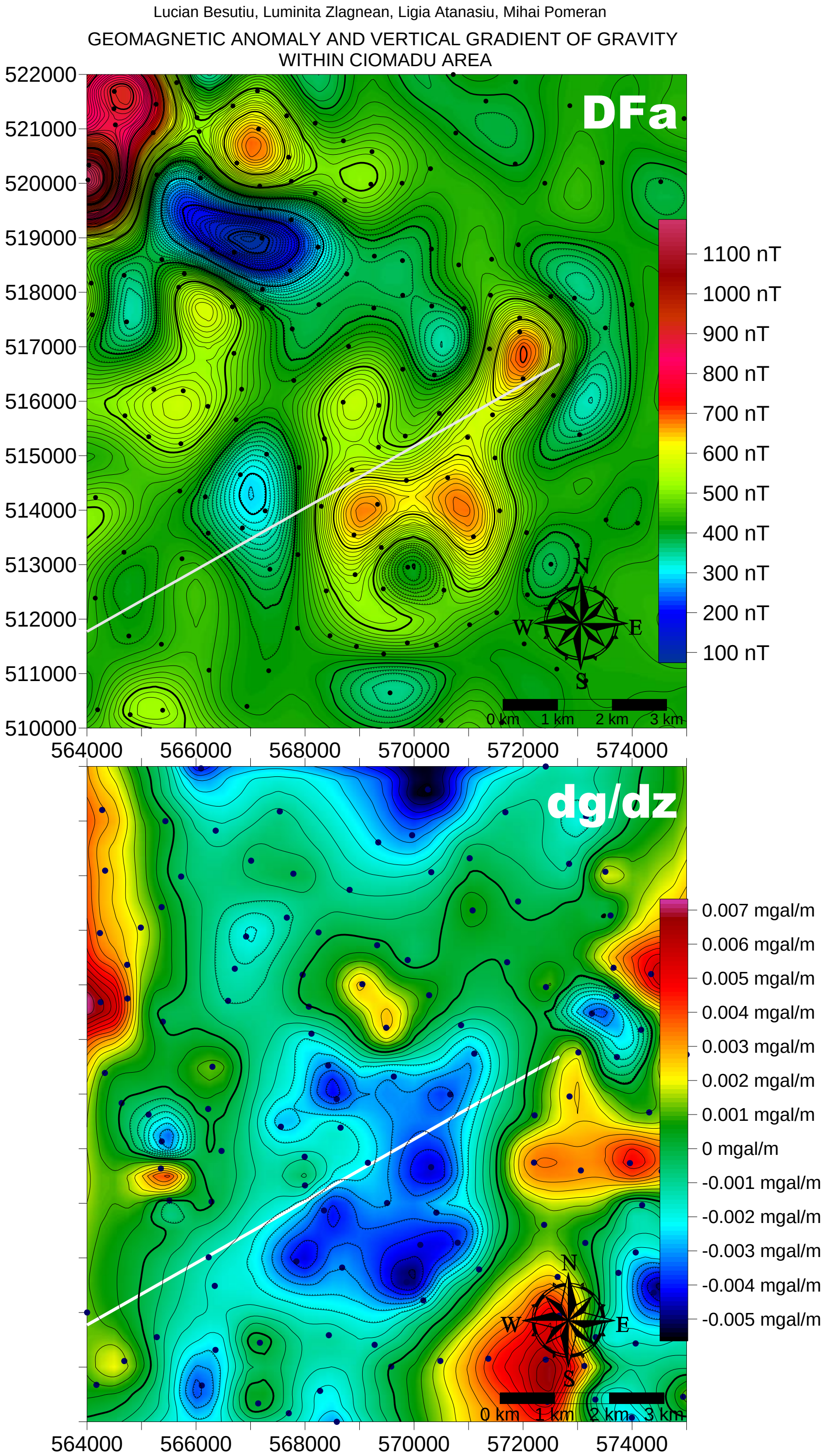


Fig. 31 Geomagnetic and gravity data within Ciomadu area and location of the interpretative line

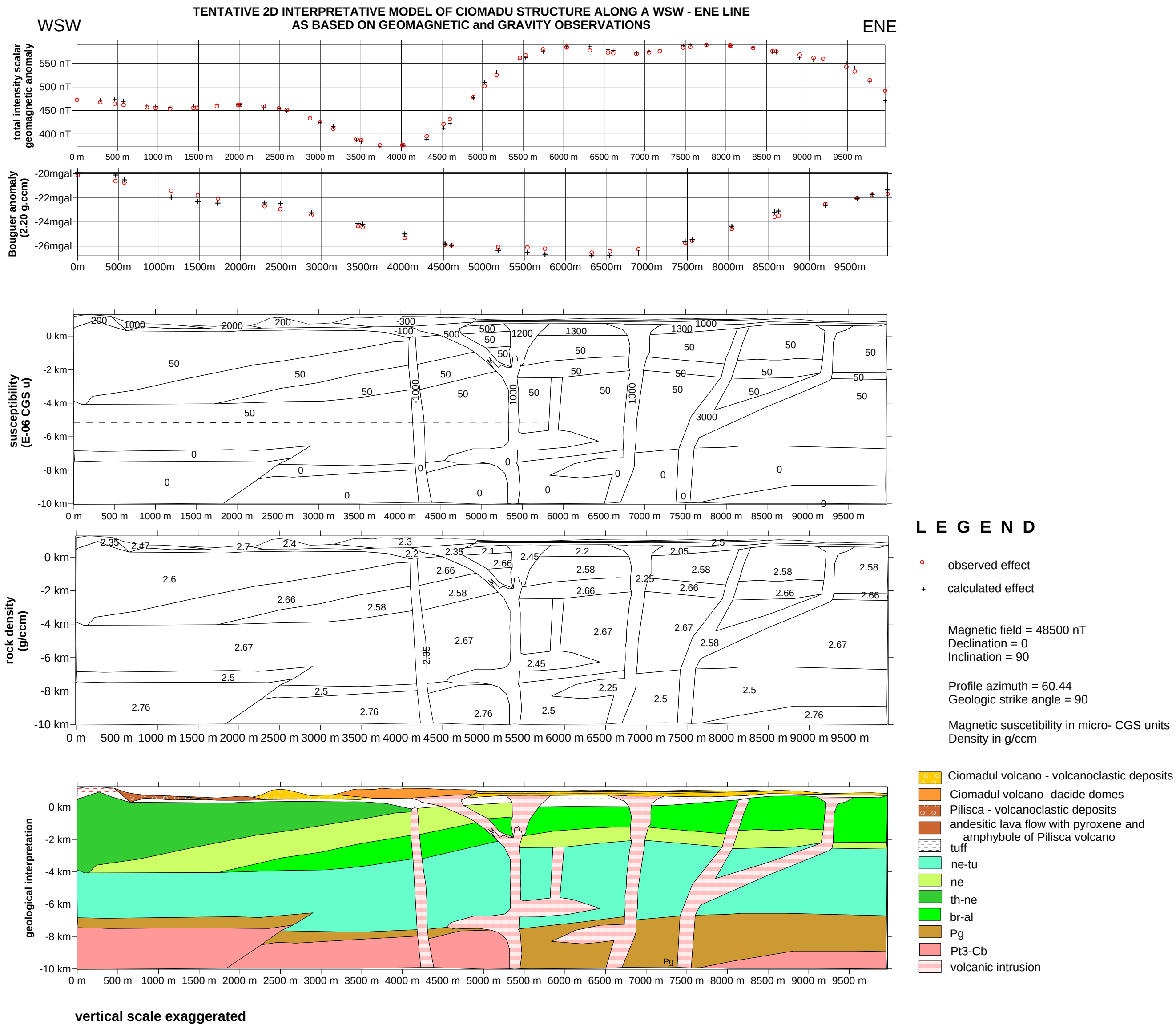


Fig. 32 Tentative 2D modelling of the geological structure of Ciomadu volcano across the StAna lake and Mohos swamp based on the integrated interpretation of geomagnetic and gravity data