

Numerical mapping using aerial geophysical and geochemical data in the NE part of central Moroccan Massif and Sub-horizontal Middle Atlas formations (Agourai and El Hajeb area)

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Abstract : This work consists in a comparison between the detected anomalies using numerical mapping with field geological data by superimposing numerical maps on the geological contours (Randrianasolo, 2009) . This technique based on aerial geochemical and geophysical data in the NE termination of Central Moroccan Massif and the Middle Atlas sub-tabular formations allows to detect the main features of this region corresponding exactly to the geological trends. So, this technique will be applied to other regions in order to precise their geological mapping.

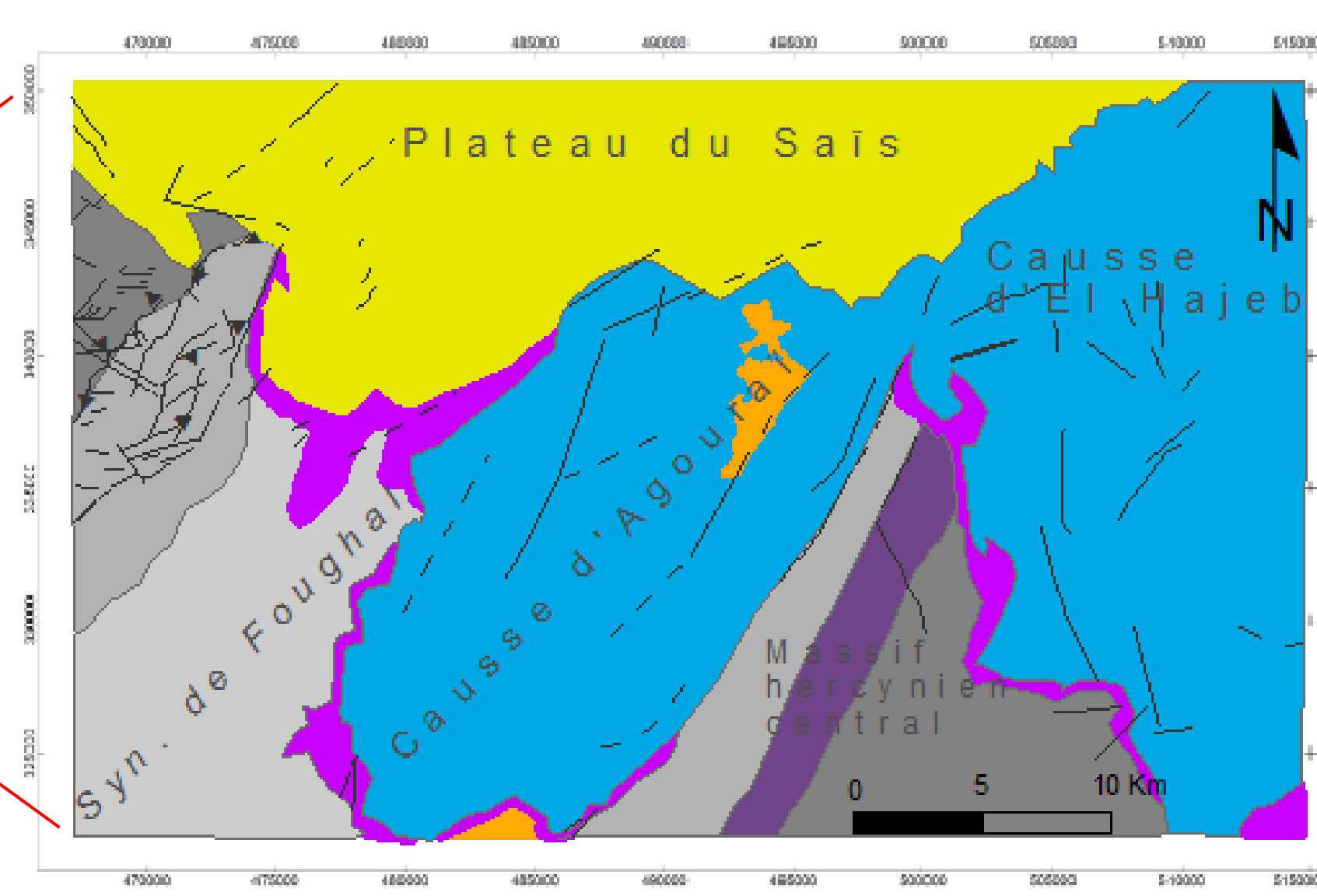
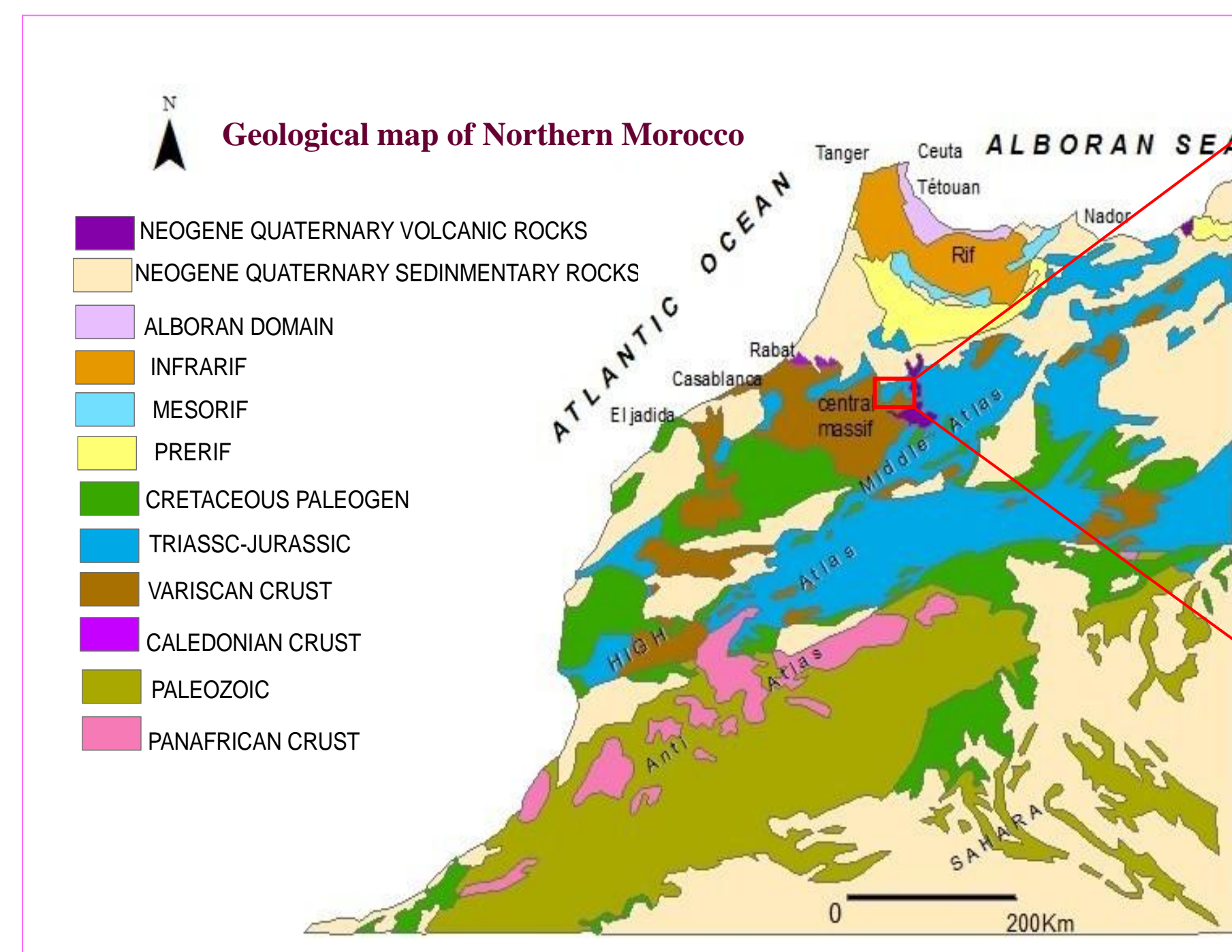


Figure 1 : Geological map of the area study

MAGNETIC DATA

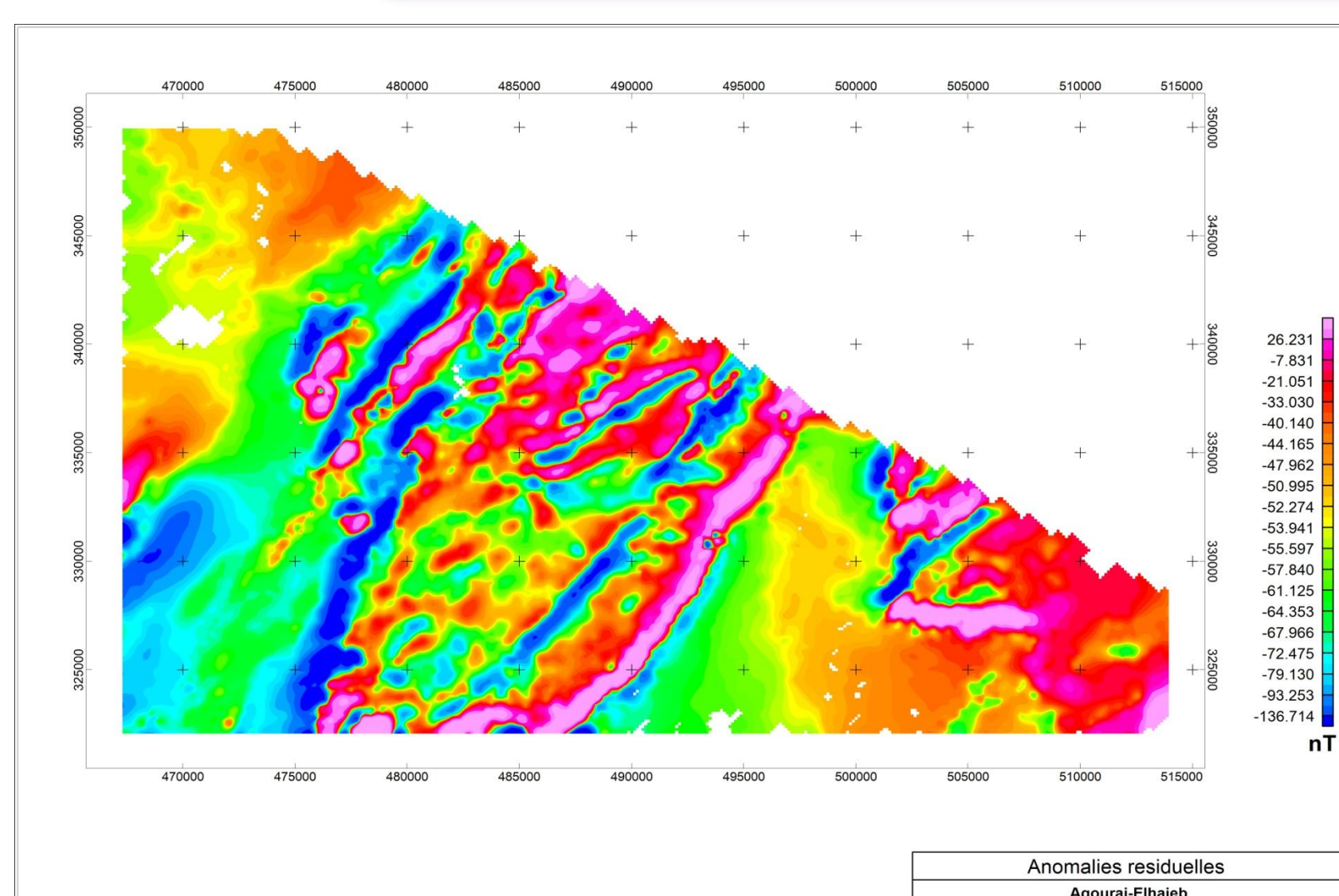
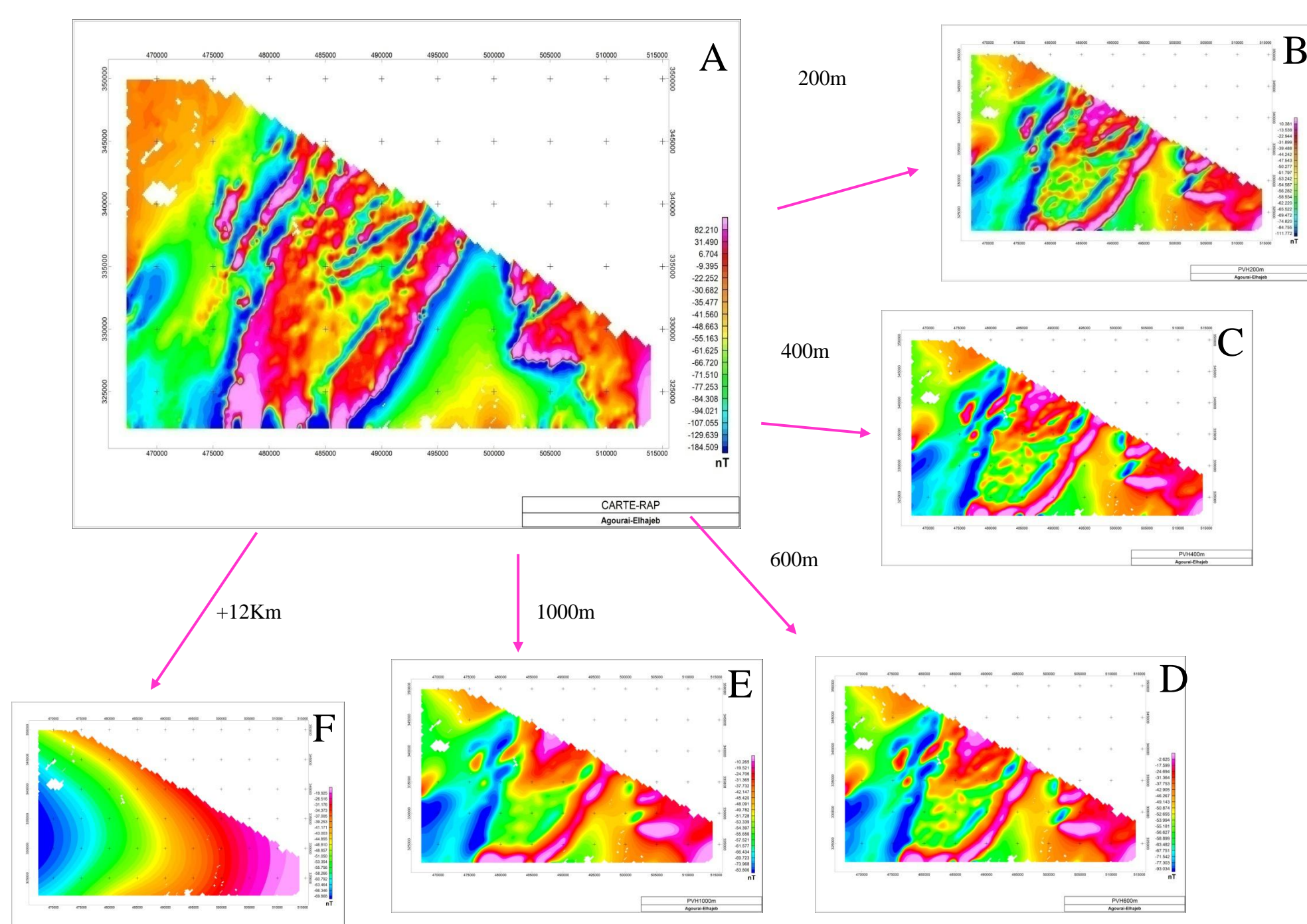


Figure 3: Map of magnetic anomalies



The digitization of magnetic measurements on which we based for the realization of the map of the magnetic anomalies, and which represents the natural variations of the terrestrial magnetic field, asks a creation of the data base by digitizing 9950 measurement points. The data are also treated with the Oasis Montaj program. The application of filtering process permits to obtain the reduced to a pole map (Figure 3), and the upward continuation technique was applied to different elevation values in order to reveal the depth structures and formations (Murthy, 2007) (Figure 4). It also permits to detect the limit between the basement and the cover. Magnetic anomalies coincide with the succession of NE-SW trending structures corresponding to anticlines and synclines hercynid folds occurring in the whole Central Moroccan Meseta (Ben Abbou, 1990). In the Agourai region (Causse d'Agourai), anomalies are oriented NE-SW parallel to the NE-trending sub-vertical major fault of Adarouch separating Paleozoic and Mesozoic formations (Colo, 1961). Also in this region, Mesozoic formations show heterogeneous magnetic responses, the northern side of the Agourai plateau (Causse d'Agourai) shows high magnetic susceptibility different of the southern part which shows average magnetic susceptibility.

Figure 4 : A. Reduced to a pole map. B. Elevation 200m, C. Elevation 400m, D. Elevation 600m, E. Elevation 1000m..... F. Elevation 12000m.

FIELD DATA

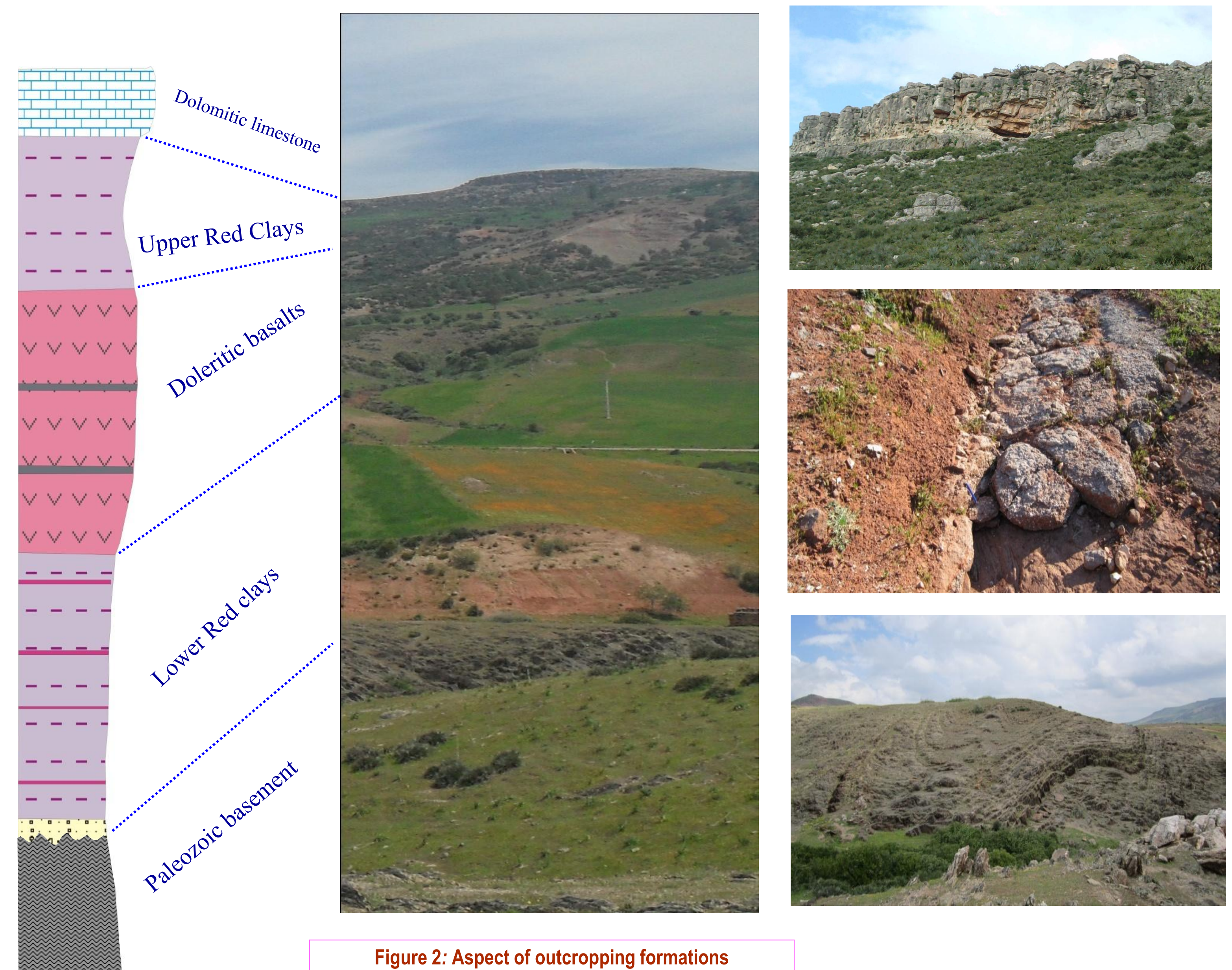


Figure 2: Aspect of outcropping formations

THORIUM (Th) SPECTROMETRIC DATA

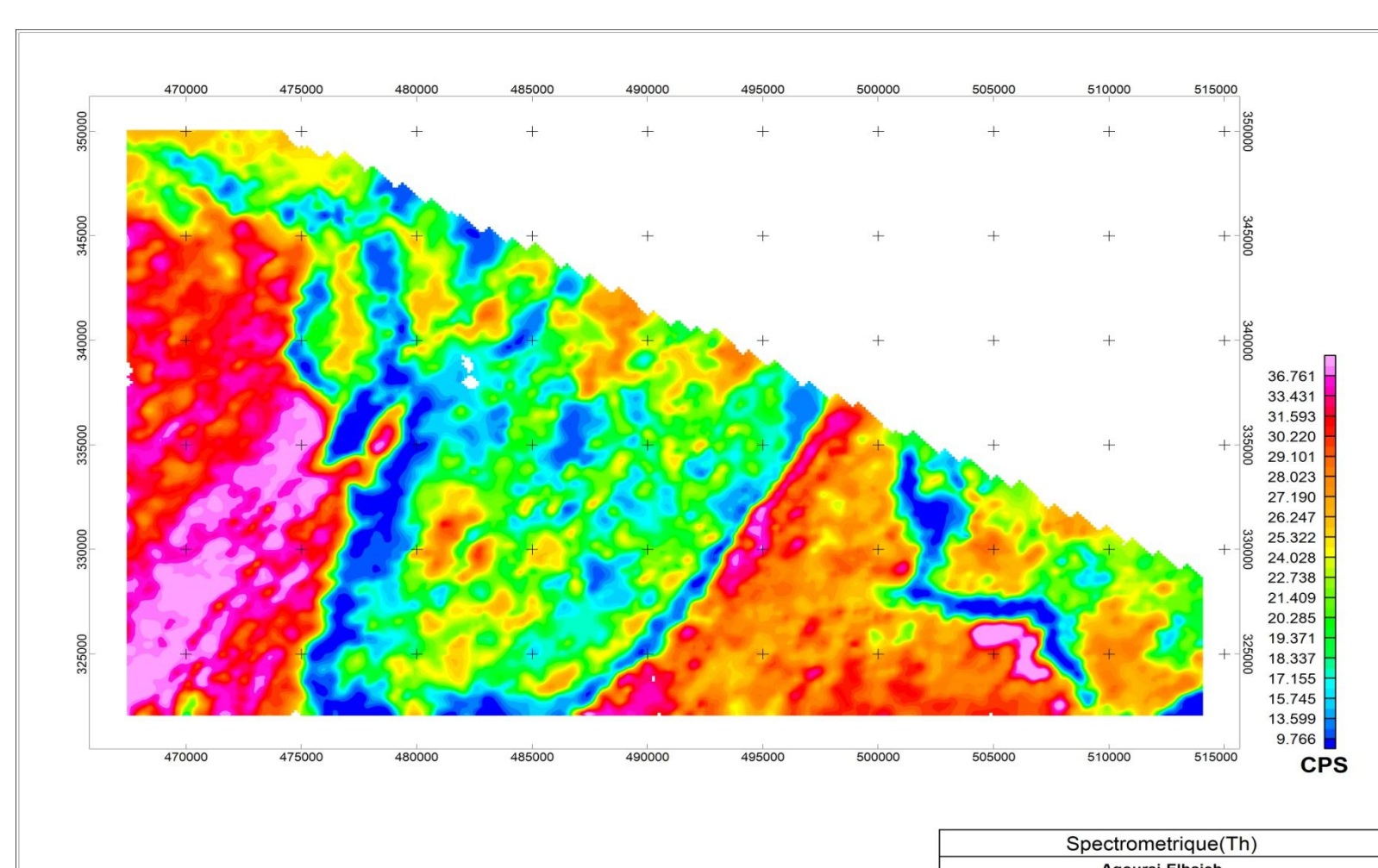


Figure 5: Radiometric anomalies of Thorium

The spectrometric map of the Thorium (Th) element traduces the gamma photons energy produced by outcrops during the disintegration of the Thorium (Minty, 1997; Wilford, 2002).

The Th radiometric anomalies map is obtained after treatment of the systematic map of the Th gamma of the whole region (Figure 5). It consists of the digitization of about 9750 measurement points in order to obtain a numerical database which is analysed with the Oasis Montaj software. The obtained results show NE-SW trending anomalies corresponding to the regional geological structures and permits to distinguish clearly the limit between the Paleozoic basement and the sub-horizontal Meso-Cenozoic cover of the Middle Atlas.

RESISTIVITY DATED 900Hz

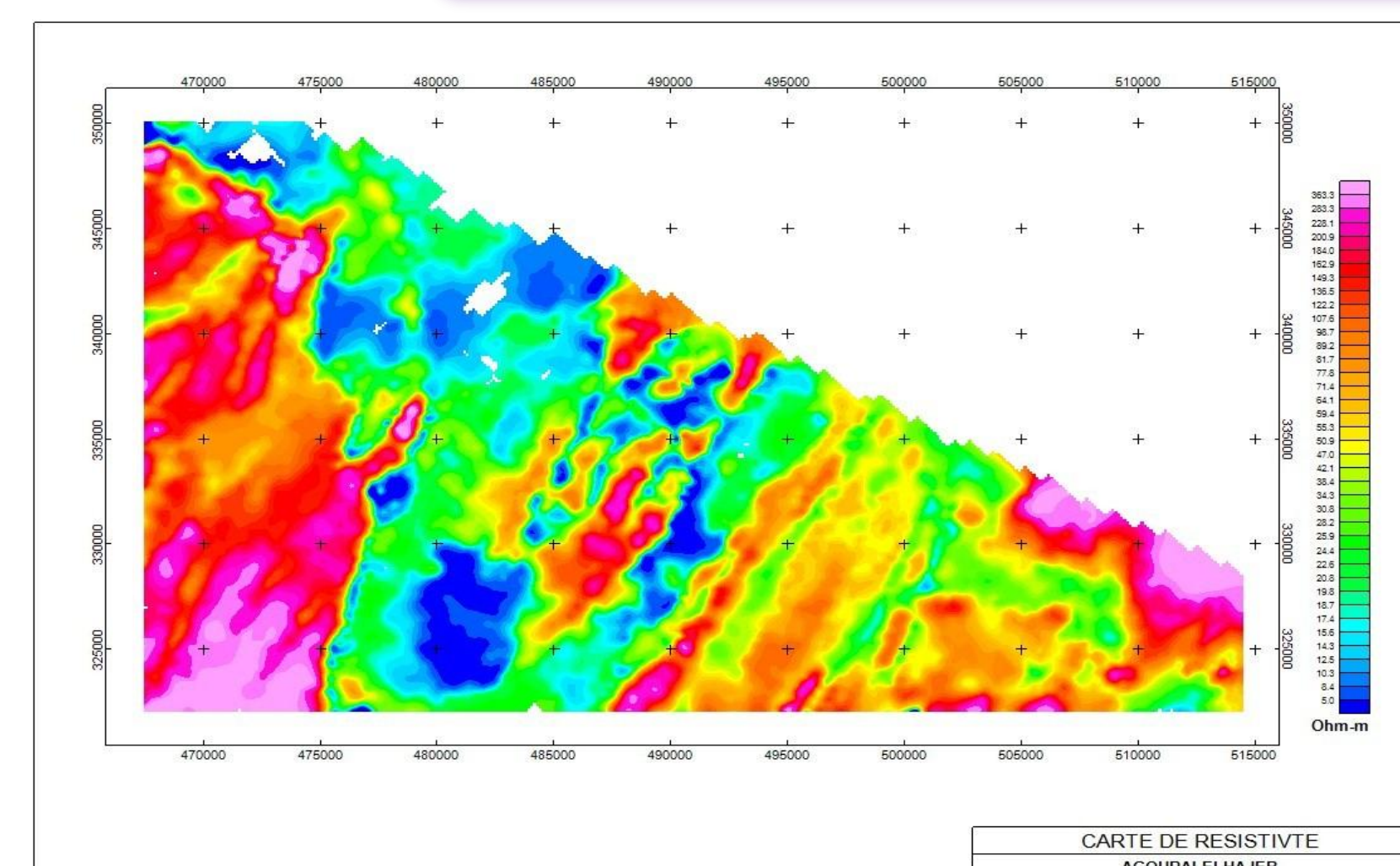


Figure 6 : Anomalies Map of Resistivity (900 Hz)

The interpretation of the apparent resistivity data of a frequency 900 Hz shown in (Figure 6), obtained by the digitization of about 6790 measurement points, permits to characterize NE-SW trending structures of this region. The investigation depth is approximately 80m. The mapping is based on the variation of the values of resistivity of geological formations according to their lithology and facies. The variations of resistivity anomalies permit also to distinguish the limit between the folded paleozoic formations and the sub-horizontal meso-cenozoic cover.

CONCLUSIONS

The processing and the analysis of geophysical and chemical (Th) data permit to have various anomalous zones according to different physical parameters of the main formations. The superimposing of these different maps allowed the realization of a synthetic map which relates the physical parameters of geological structures and different outcropping rocks (Figures 1 & 2). Thus the techniques used seem to be appropriate for indirect mapping of all geological features (formations, folds and faults structures, dykes and sills).

So, it's possible to : (i) precise the limits between the Paleozoic basement and the Meso-Cenozoic cover, (ii) determine various spectrometric and geophysical anomalies according to NE-SW direction compatible with the regional geological structures trends: folds and faults occurring in the Paleozoic basement and the NE-SW oriented system faults in the Mesozoic cover of the Middle Atlas (Agourai area) which seem to be the result of the reactivation of basement faults (Ben Abbou, 1990 ; Hoepffener, 1994 ; Tahiri, 1994).

Thus, this strong correlation existing between the determined anomalies and the regional structures shows that this numerical mapping could be used in other regions where access is difficult in order to put some corrections to various geological existing maps.

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