3 SYSTEMATIC ANALYSIS OF THE BOUGUER ANOMALIES OF SWITZERLAND

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ABSTRACT

A systematic analysis of the Bouguer anomalies of the western part of the Molasse basin of Switzerland has been done using Euler deconvolution in two and three dimensions and by analytic signal interpretation.

In a first step regional and residual fields were extracted from the SGPK gravity data base to produce grids of 256 by 256 in order to systematically apply FFT for filtering and deconvolution. In order to get data free from the interferences of small quaternary basins a digital model of the top of the Molasse has been produced and modelled in three dimensions.

The results of the deconvolution and of the analytic signal interpretation is presented in form of maps and of three dimensional blocks diagrams.

3.1 PEPARATORY WORK

In order to cover at best the Molasse basin and the Jura mountains ten grids 256 by 256 were extracted from the gravity data used for the Swiss Gravity Atlas at 100000 scale. (fig1)

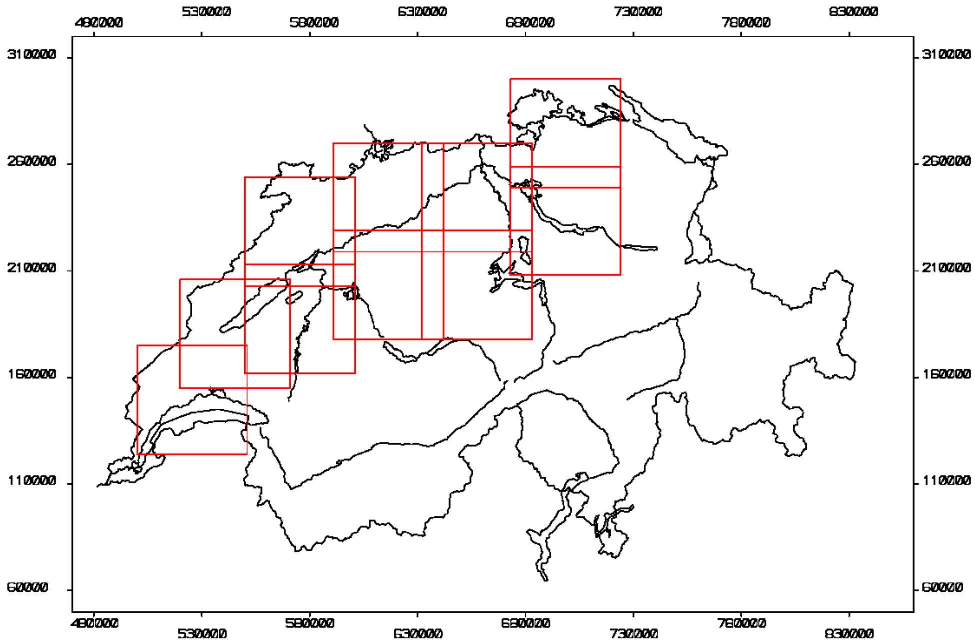


Figure 1. Locations of the grid of 256 by 256 used for data processing and interpretation.

For each grid three different regional and residual fields were computed. For these algebraic polynomials of degree 1 to 3 were adjusted by means of a LSQ fit procedure. An example of a Bouguer anomaly and its 3rd degree residual is shown in figure 2.

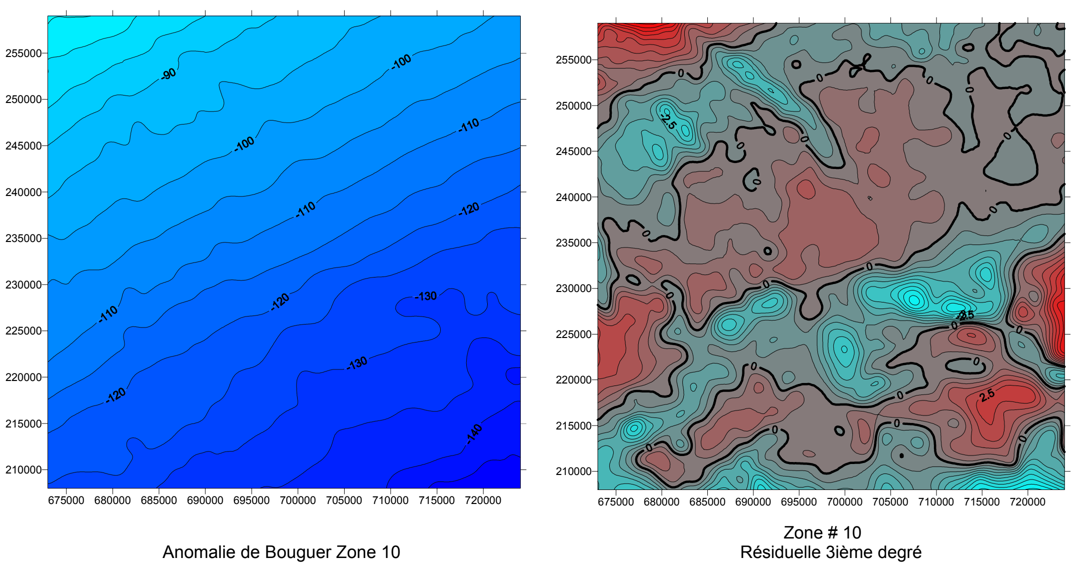


Figure 2: Example of a Bouguer anomaly grid of 256 by 256 and the corresponding residual field of 3rd degree

3.2 INTERPRETATION IN TWO DIMENSION

For this interpretation profiles crossing the most prominent two dimensional anomalies were extracted from the residuel grids. At the same time the vertical gradient of the anomlies were computed.The figure 3 shows the location of these profiles

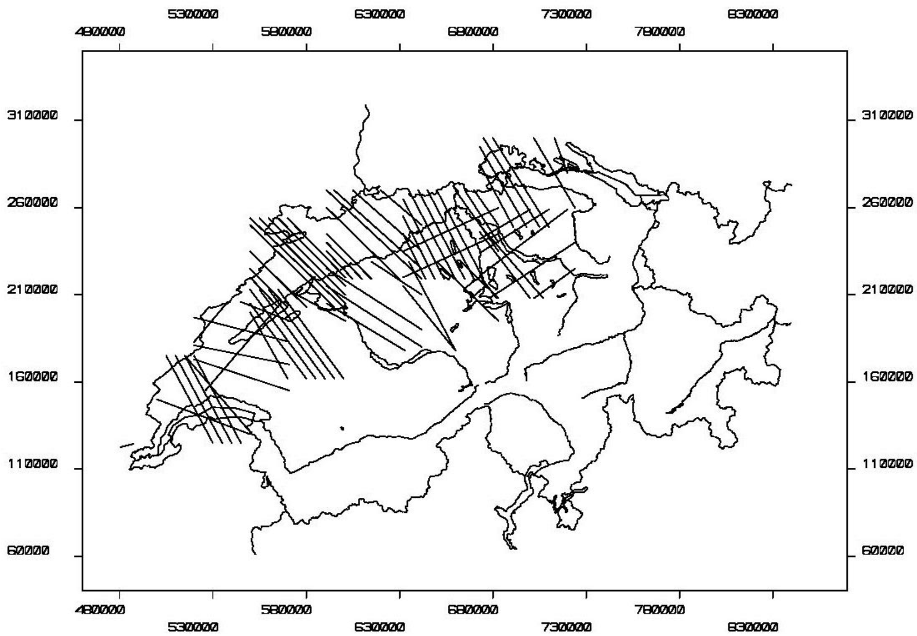


Figure 3 : Locations of the profiles used for the two-dimensional interpretation

Every profile has been interpretd by two methods involving the anomalous vertical gravity gradient : By Euler deconvolution and by the analysis of the analytic signal

Figures 4 to 7 show some examples of the results obtained along the prfiles by these two methods.

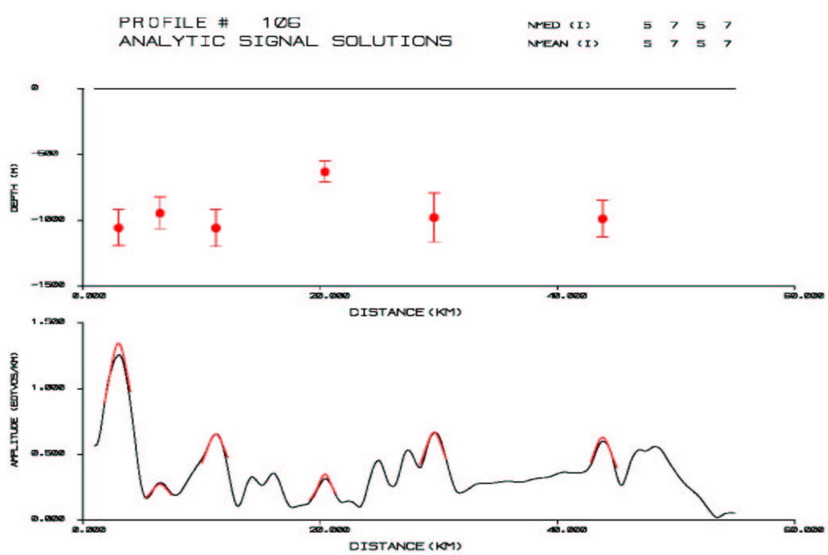


Figure 4: Example of the depth solutions obtained along profile 106 by the analytic signal method

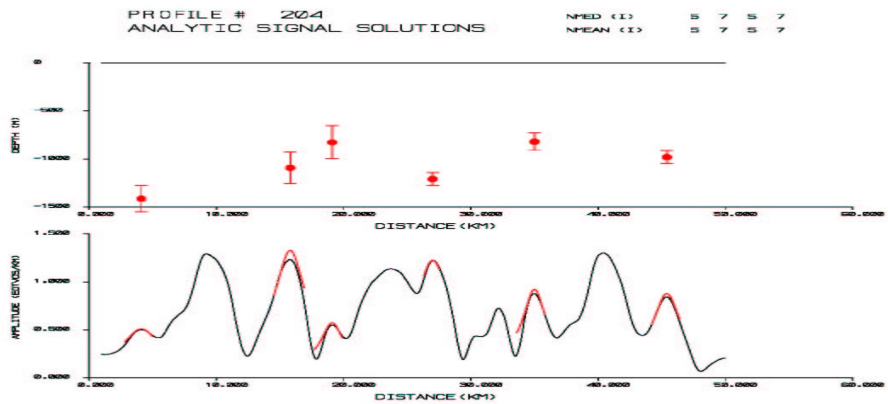


Figure 5: Example of the depth solutions obtained along profile 204 by the analytic signal method.

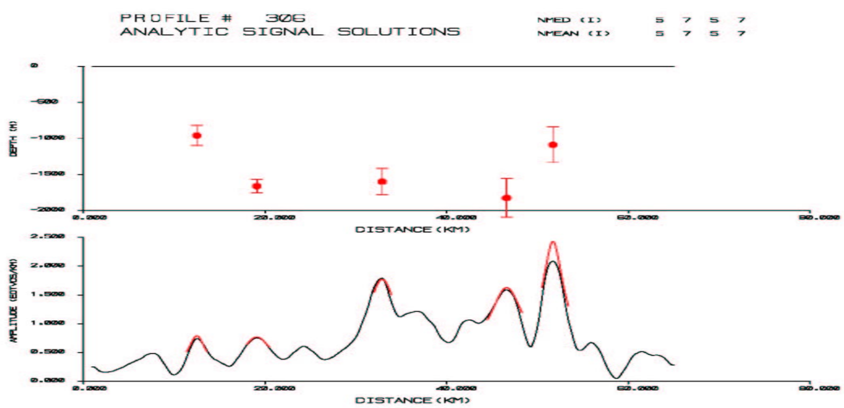


Figure 6: Example of the depth solutions obtained along profile 306 by the analytic signal method.

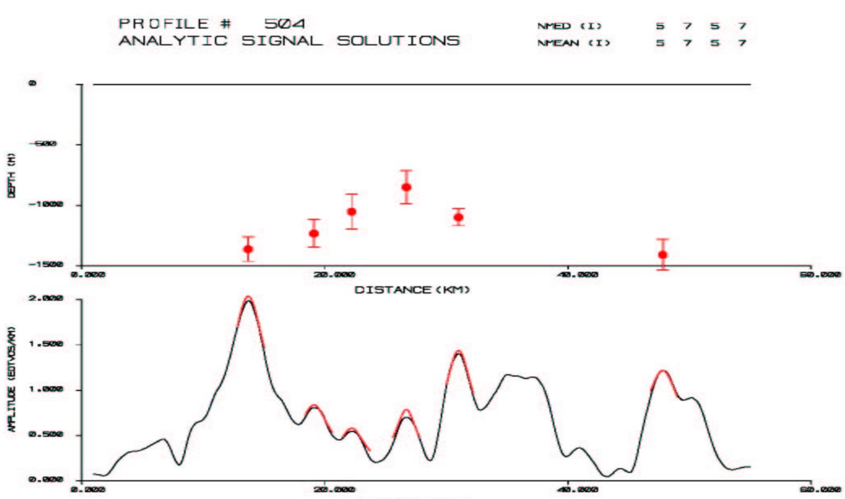


Figure 7: Example of the depth solutions obtained along profile 504 by the analytic signal method.

Figures 8a to 8e show the locations under the topography of the densities discontinuities obtained by the analytic method of the signal for the zone 1 to 5.

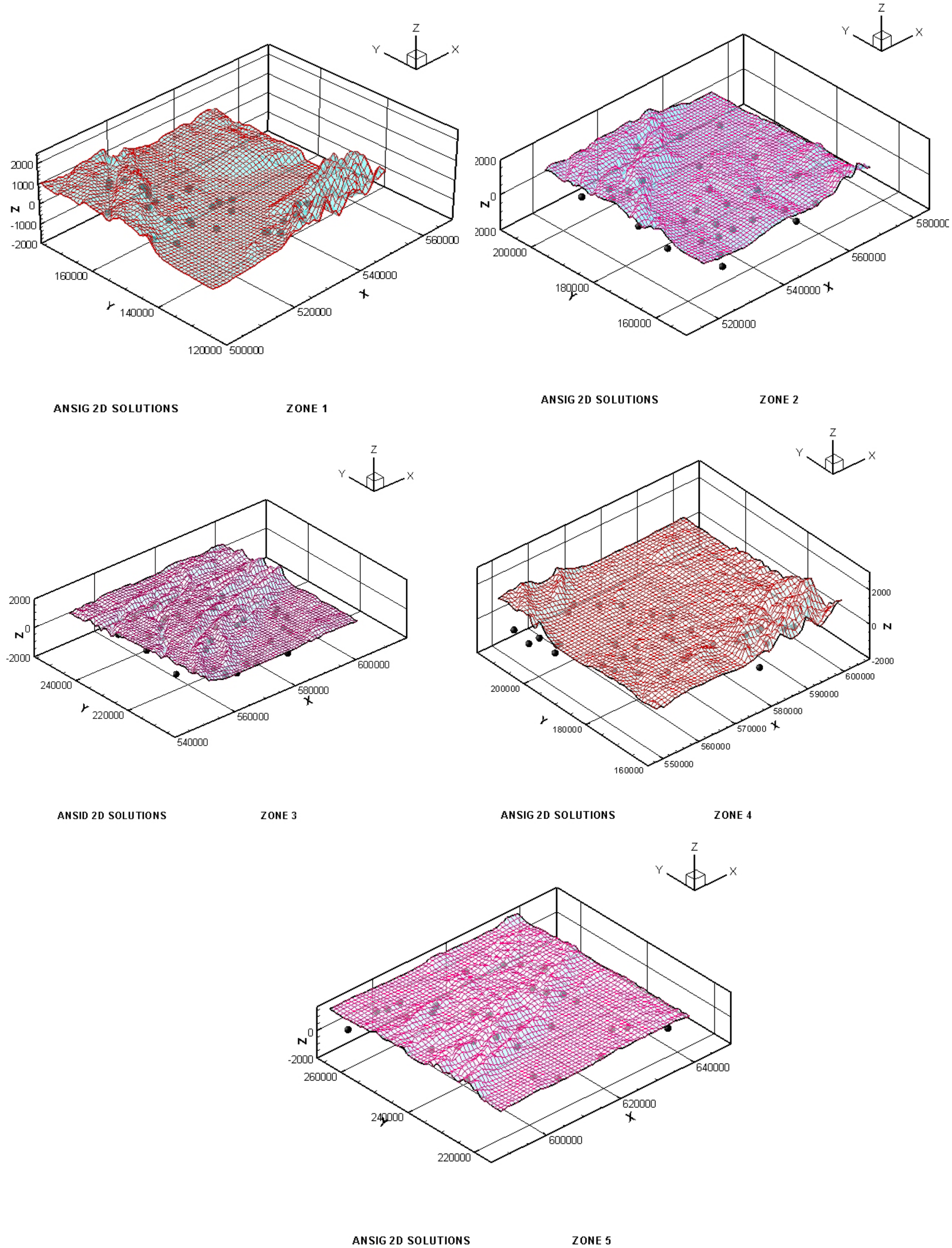


Figure 8a to 8e: Locations of the densities discontinuities of zone 1 to 5, under the topography.

The same profiles were also interpreted by Euler deconvolution of the anomalous vertical gravity gradient. Some examples of the results along profiles are shown in figures 9 to 12

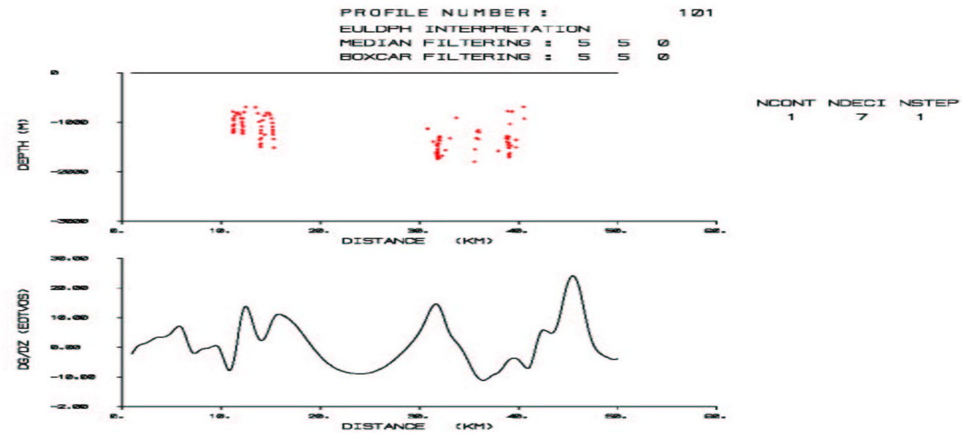


Figure 9 : Location of the discontinuities of density along profile 106 obtained by Euler deconvolution of the anomalous vertical gradient

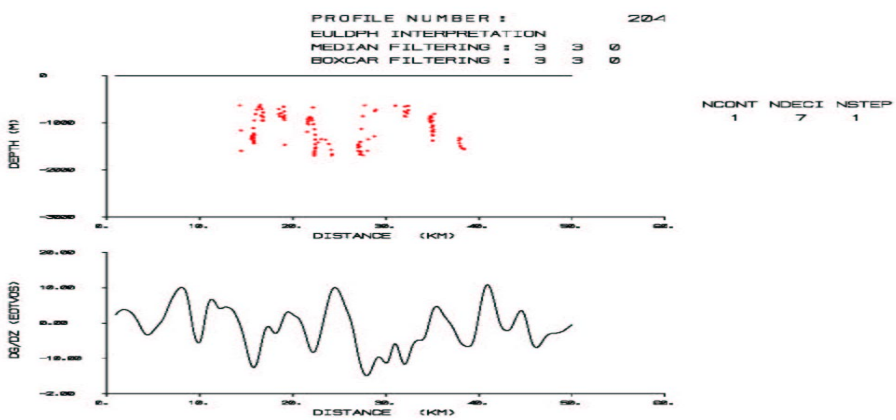


Figure 10 : Location of the discontinuities of density along profile 204 obtained by Euler deconvolution of the anomalous vertical gradient

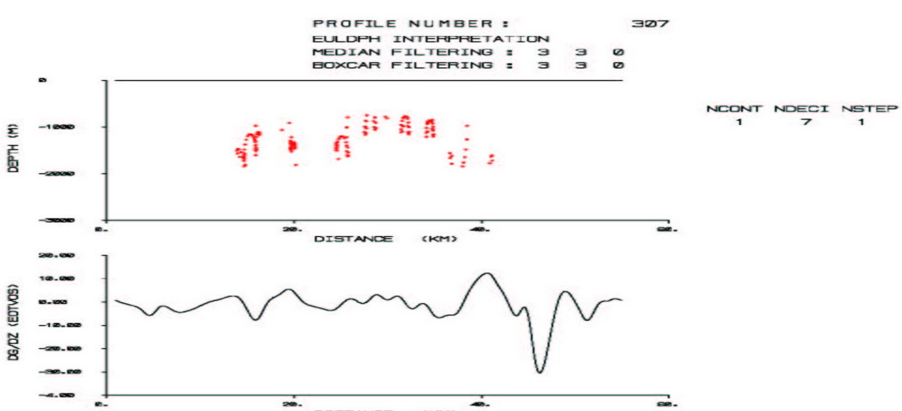


Figure 11 : Location of the discontinuities of density along profile 307 obtained by Euler deconvolution of the anomalous vertical gradient

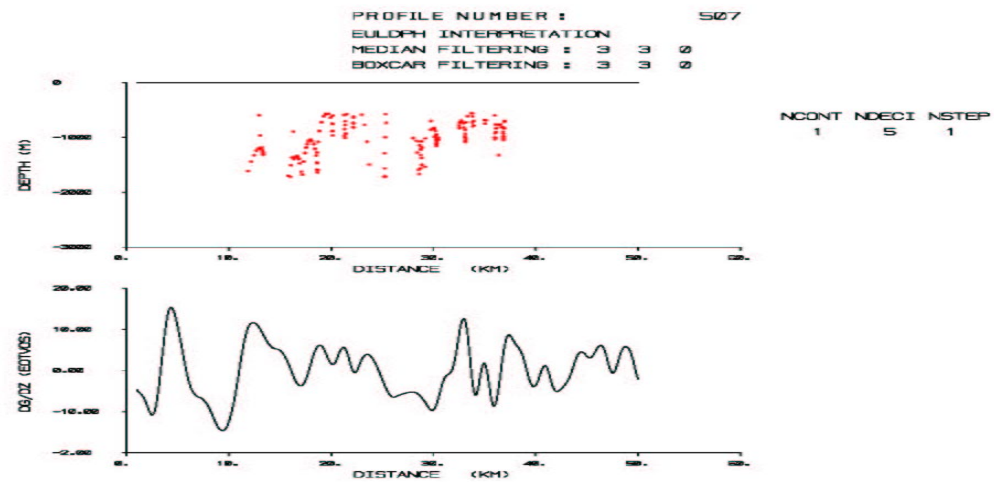
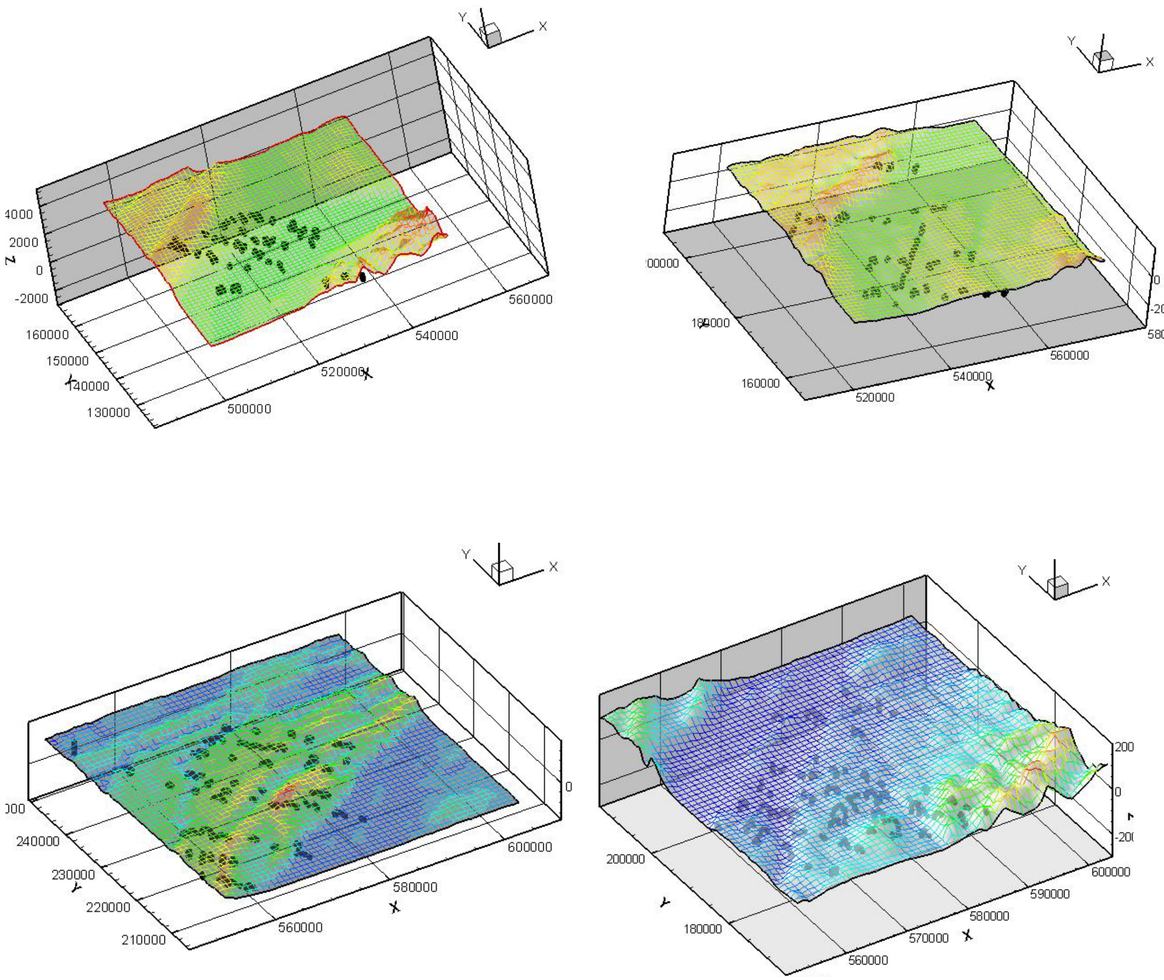


Figure 12 : Location of the discontinuities of density along profile 507 obtained by Euler deconvolution of the anomalous vertical gradient

Like for the results obtained by the analytic signal method the results of the 2D Euler deconvolution are presented with their locations under the topography (figure 13a to 13 b)



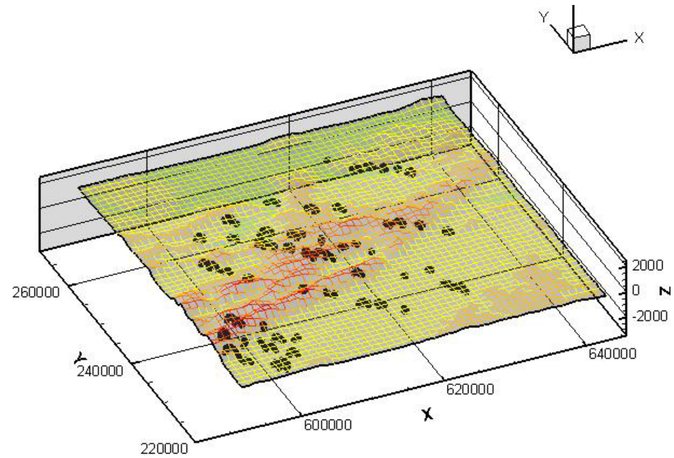
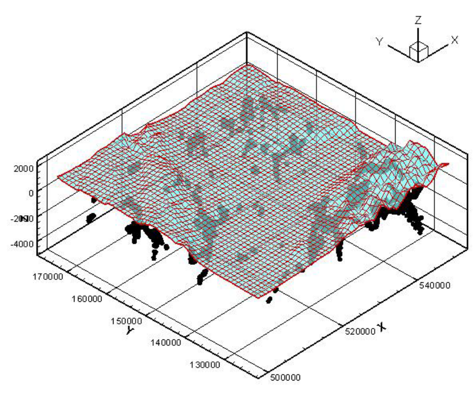
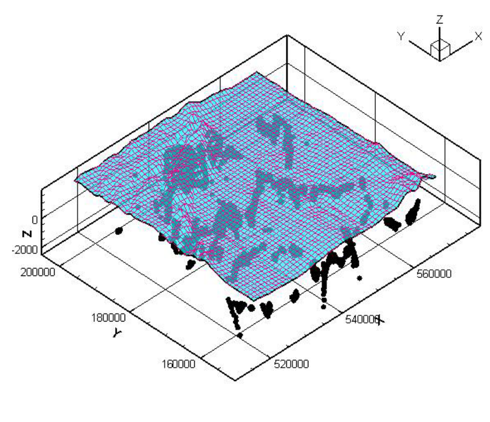


Figure 13a to 13e : Locations of the densities discontinuities obtaned by Euler deconvolutions of the anomalous vertical gravity gradient.

The Euler deconvolution in three dimension was also applied to the data of zones 1 to 5. A comparaison of the results of the three techniques will be performed when all the zone will be already interpreted (probably at the end of 2007)

Some of the results of the 2D Euler deconvolution are presented in three dimension in figures 14a to 14e





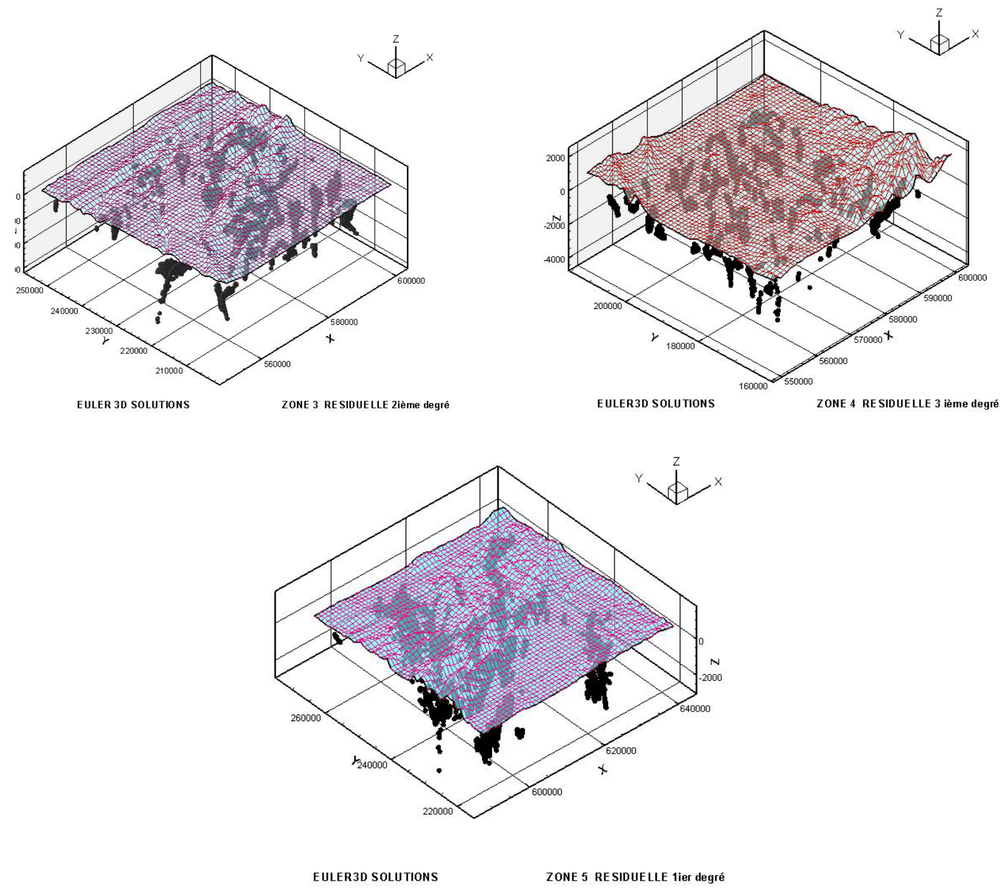


Figure 14a to 14e: Locations of the densities discontinuities obtained by Euler deconvolutions in 3D of the anomalous vertical gravity gradient.

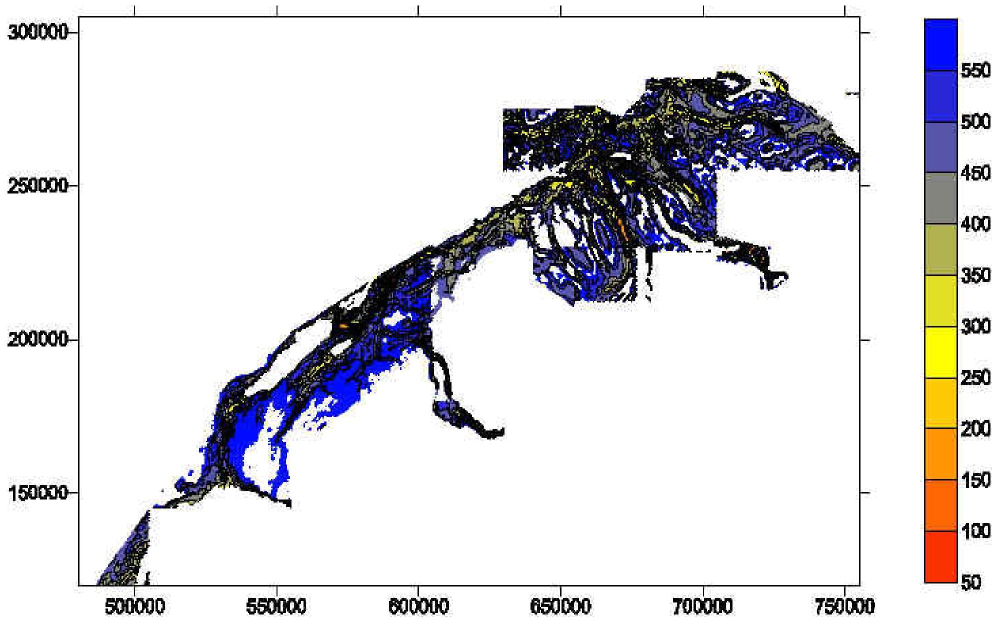
3.3 STRIPPING

As already pointed out a great part of the alpine valleys and the majority of the Molasse basin are filled and/or covered by recent alluvial sediments. These sediments have a density significantly lower than the Molasse or the alpine rocks and therefore, produce anomaly, some time of strong amplitude, of short wavelength masking weaker underlying anomalies. In order to be able to see these possible underlying anomalies it was decided to strip off the Bouguer anomaly from the effect of these recent sediments.

Methodology and results

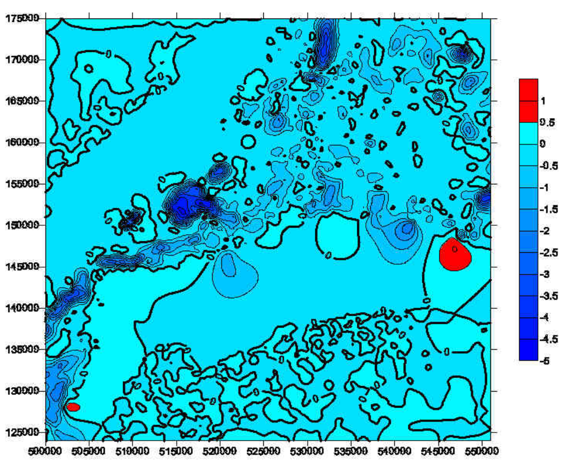
The isohypses of the maps of the top of the Molasse of Wild (1984) and Pugin (1987) were digitalized to produce x,y,z data. From these vectors data a grinding procedure was applied to produce matrix data with mesh size of 250 by 250 meters in models of 25 by 25 kilometres.

Extracting the altitude of the RIMINI model of the Swiss Federal Office of Topography created the upper part of the models. Finally the zones containing lakes or area without data (Prealps, Jura) were masked.

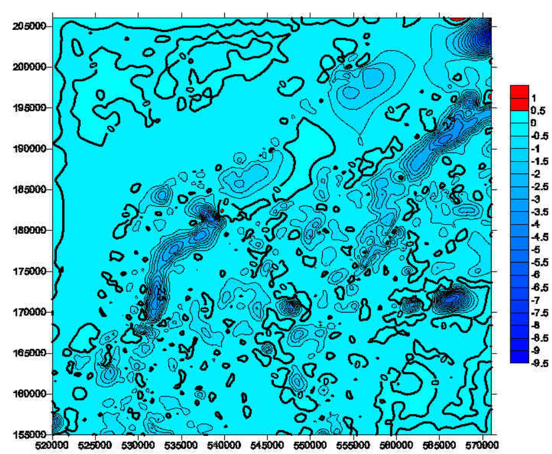


Isohypses of the basis of the recent sediments

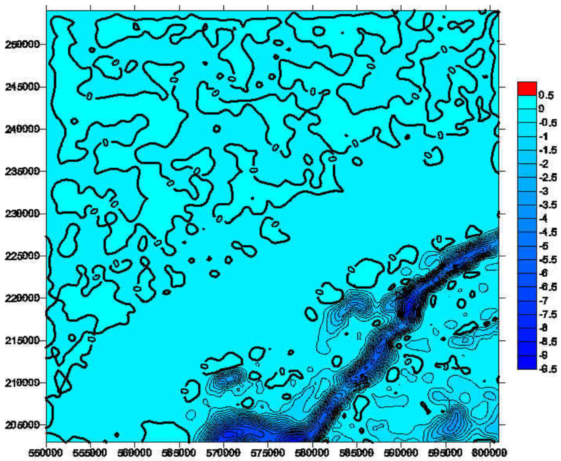
The five following figures show the effect of the recent sediments on the Bouguer anomalies of zones 1 to 5



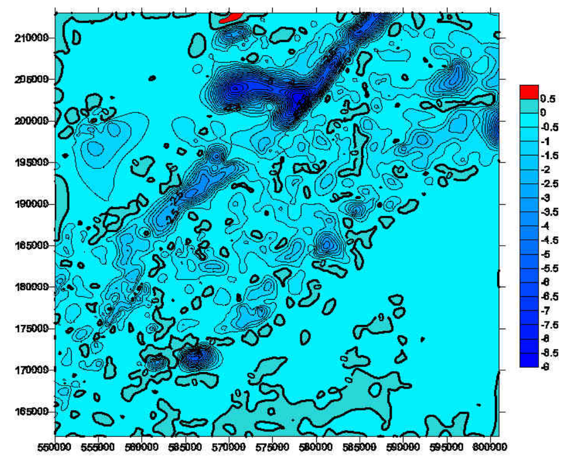
ZONE 01
Effect of the recent sediments



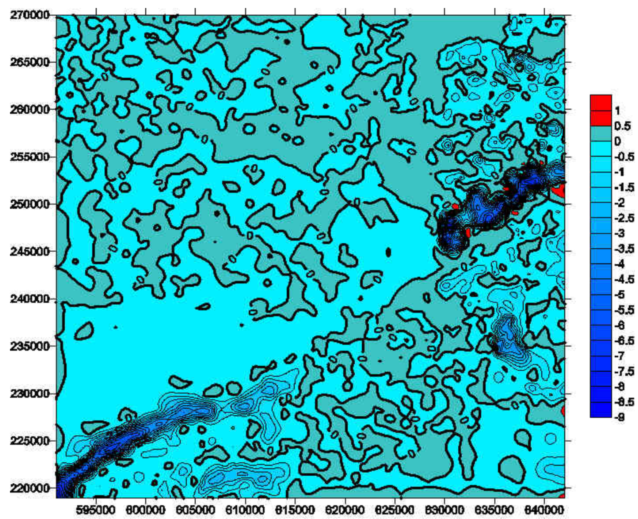
ZONE 02
Effect of the recent sediments



ZONE 03
Effect of the recent sediments



ZONE 04
Effect of the recent sediments



ZONE 05
Effect of the recent sediments

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