# Gravity Highs in the Central Andes: the CAGH and the southern Altiplano

TP C6 / Z2B

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SFB 267

## Introduction

In autumn 1999 new gravity observations were recorded in the area of the Western Cordillera, and the southern Altiplano of Bolivia. In total some 900 new observations complete the already existing database of the YPFB, the Instituto Geografico Militar in La Paz and our own MIGRA data sets in N Chile and the Puna of NW Argentina. Field work in that remote area has been done under difficult climatical and logistical conditions. Numerical interpretations of the completed data sets will help to answer questions concerning the eastern extension of the gravity lows in the volcanic arc and the detection of the Kenyani–Uyuni Lineament in the southern Altiplano.

Modeling and data processing in the area of the "Central Andean Gravity High, CAGH" combined all available areal information (e.g. Palma et. al. 1988, Lucassen et al., 1999 or Lessel, 1998) to shade new light on geometry, extension and structure of causing domains in relatively shallow crustal levels (max. depths: 10 – 15 km).

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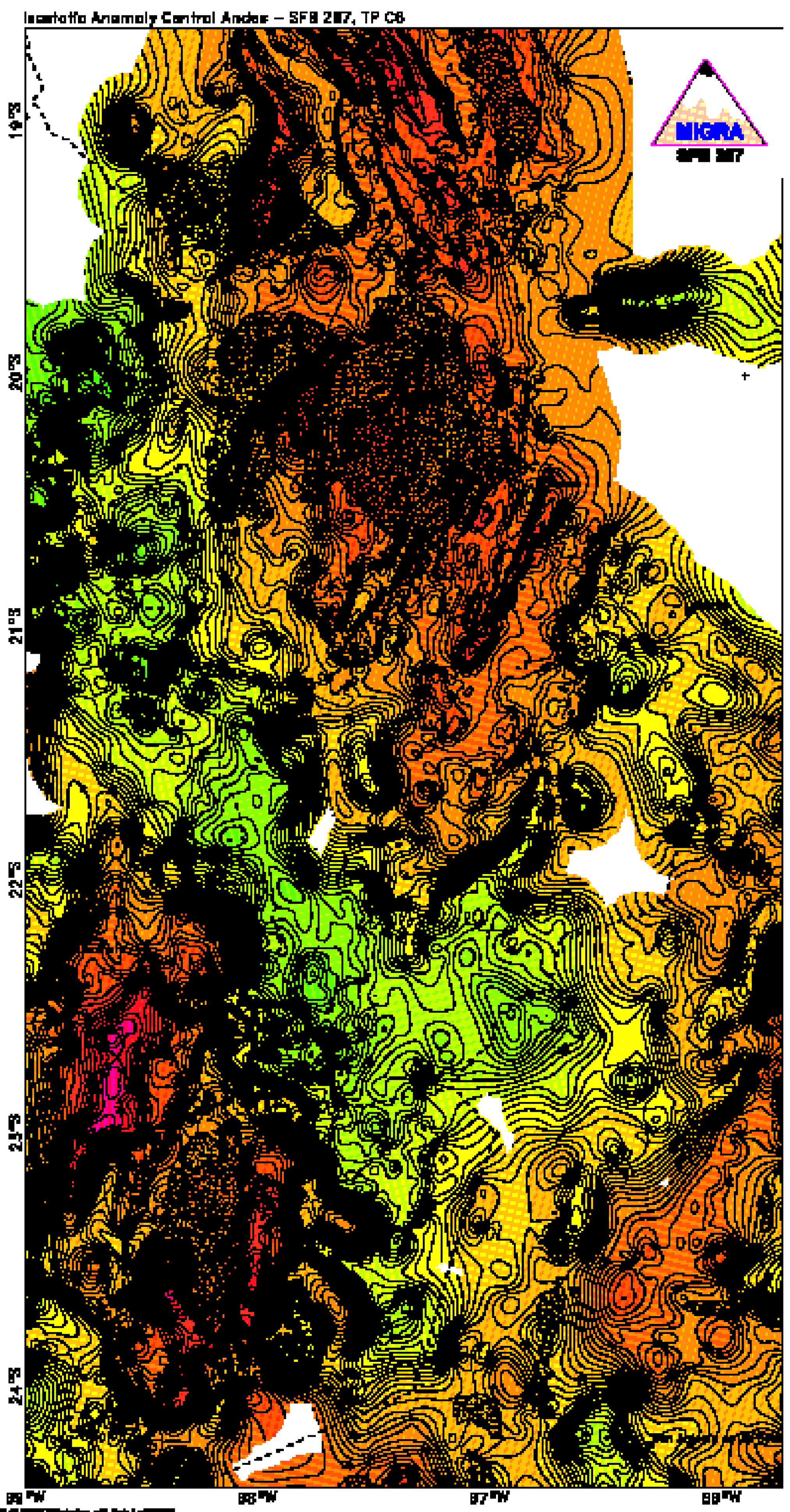
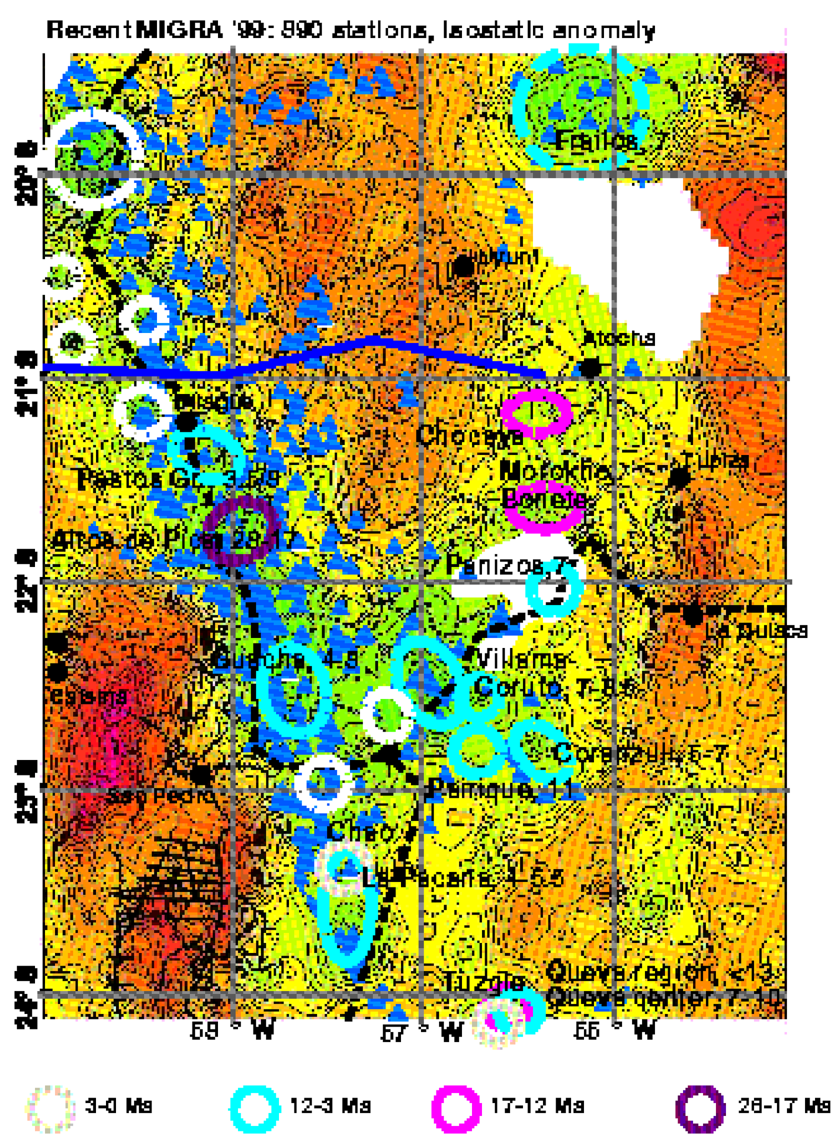



Caldera complexes by: B. Coira, S.Kay, R. Allmendinger and G. Wörner.

### Errors of gravity observations

Errors calculated in loops between gravity base stations provide information on the accuracy of field observations. The figure at the right side shows the results of this calculus and enrols for the good quality of data acquisition; all observations have been conducted by LaCoste & Romberg gravity meters.

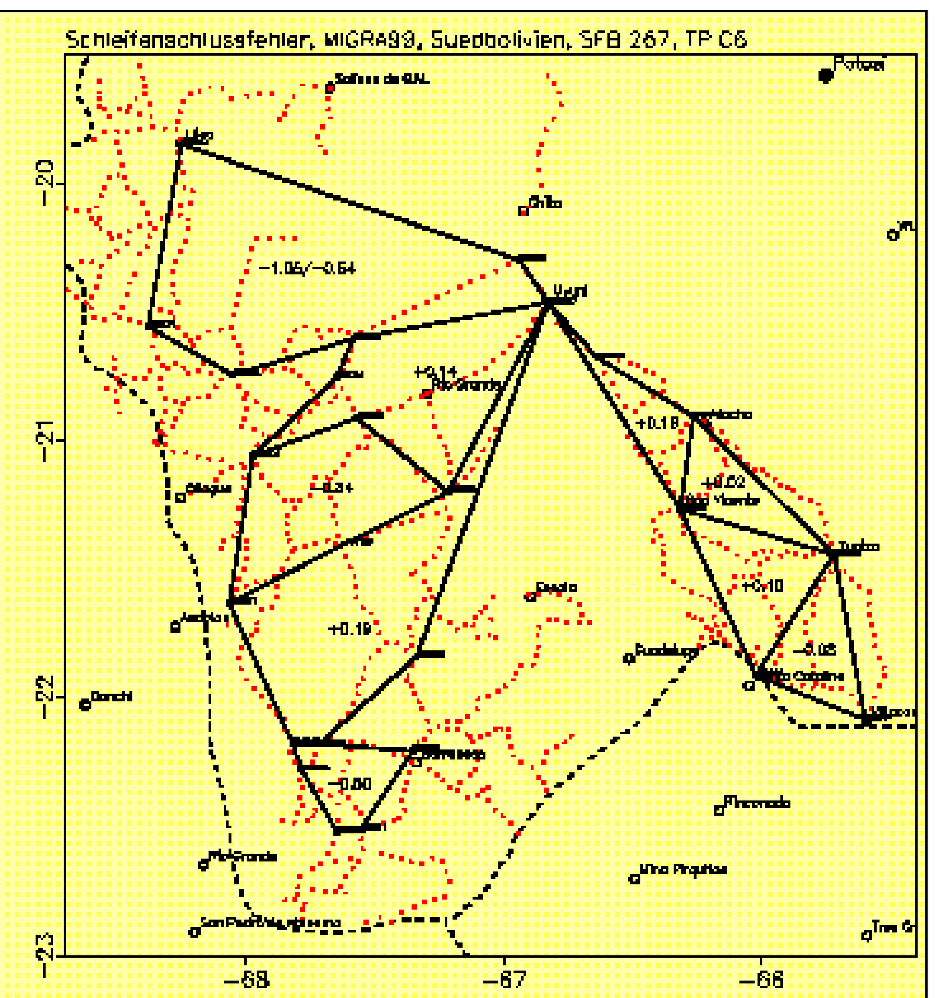
Repeating measures were taken at 77 sites with an average error of $0.18 \cdot 10^{-5}$ m/s$^2$; maximum error was: $0.94 \cdot 10^{-5}$ m/s$^2$. Two examples give more insight into the loop errors:

| Observations between: | difference ($10^{-5}$ m/s$^2$) | gravity–meter no. |
|---|---|---|
| Uyuni – Colcha K | + 9.37 | 411 |
| Colcha K – Laguna Colorada | –103.76 | 592 |
| Laguna Colorada – Soniquera | + 71.24 | 592 |
| Soniquera – Uyuni | + 22.98 | 998 |

total error in loop 1: $-0.17 \cdot 10^{-5}$ m/s$^2$

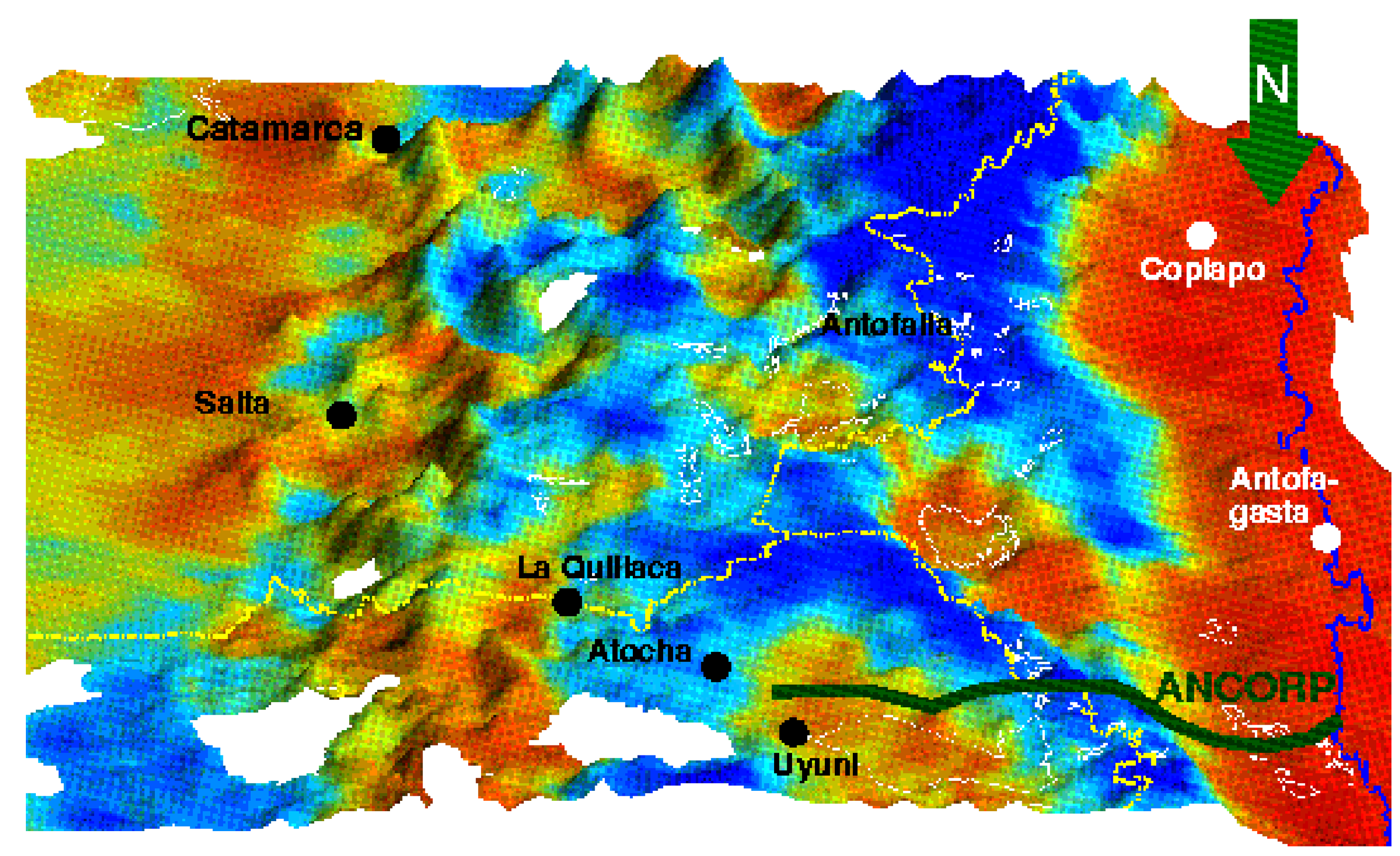
| Observations between: | difference ($10^{-5}$ m/s$^2$) | gravity–meter no. |
|---|---|---|
| Uyuni – Laguna Colorada | –94.51 | 592 |
| Laguna Colorada – Uyuni | 94.53 | 592 |

total error in loop 2: $+0.02 \cdot 10^{-5}$ m/s$^2$



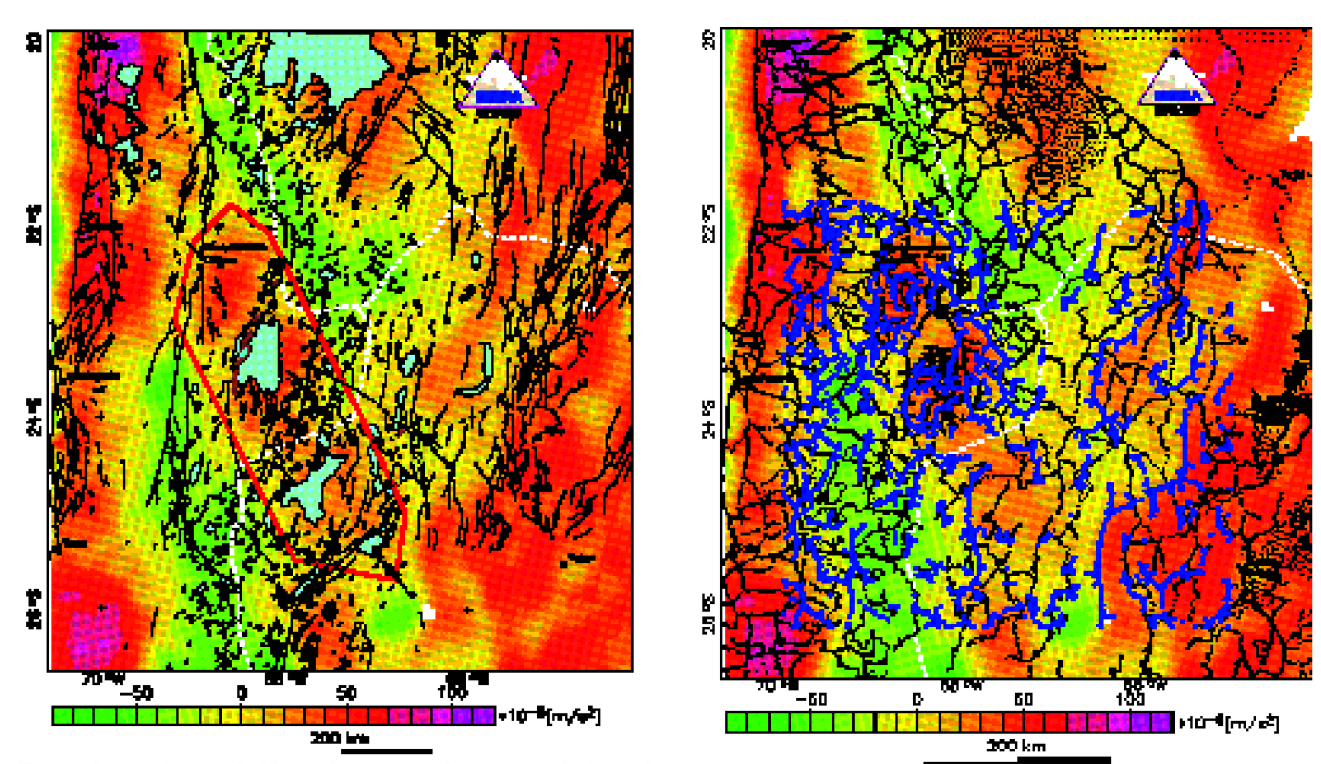

### Isostatic residual field

**The maps around portrayal the residual gravity field, which was calculated by subtracting an "Vening–Meinesz type" regional gravity field from the observed Bouguer anomaly. The remaining local anomalies (normally) are caused by density inhomogeneities, which are located between the Earth's surface and the compensating level, in a rather first approximation is this the MOHO.**



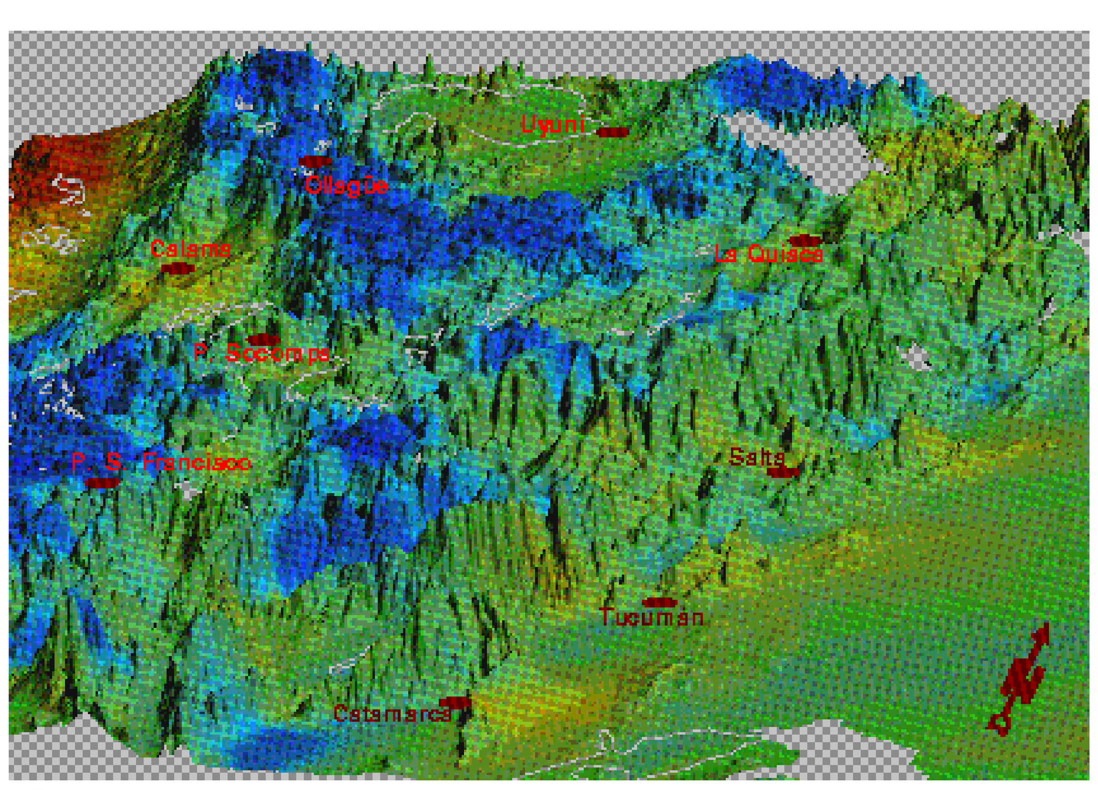

### Southern Altiplano

The figure above shows in a perspective view from north to south the gravity residuals projected on the topography. Most of the negative residuals are concentrated at the edges of topography. The Jurassic forearc is characterized by strong positive values. The CAGH disappears in the SE in front of the negative anomaly of the Cerro Galan volcanic complex. More to the east in the Andean foreland (Chaco), positive residuals are always present, which can be related to the flexure of continental crust or, in a very local scale, to erosional processes.




### Gradients of the isostatic residuals

Gravity anomalies, sites and gradients were combined to show the main trends of gravity field. The CAGH is surrounded by steep gradients which give hints to rather abrupt changes of density in superficial levels. Steep gradients inside the positive gravity complex point to faults which separate density domains inside this area.



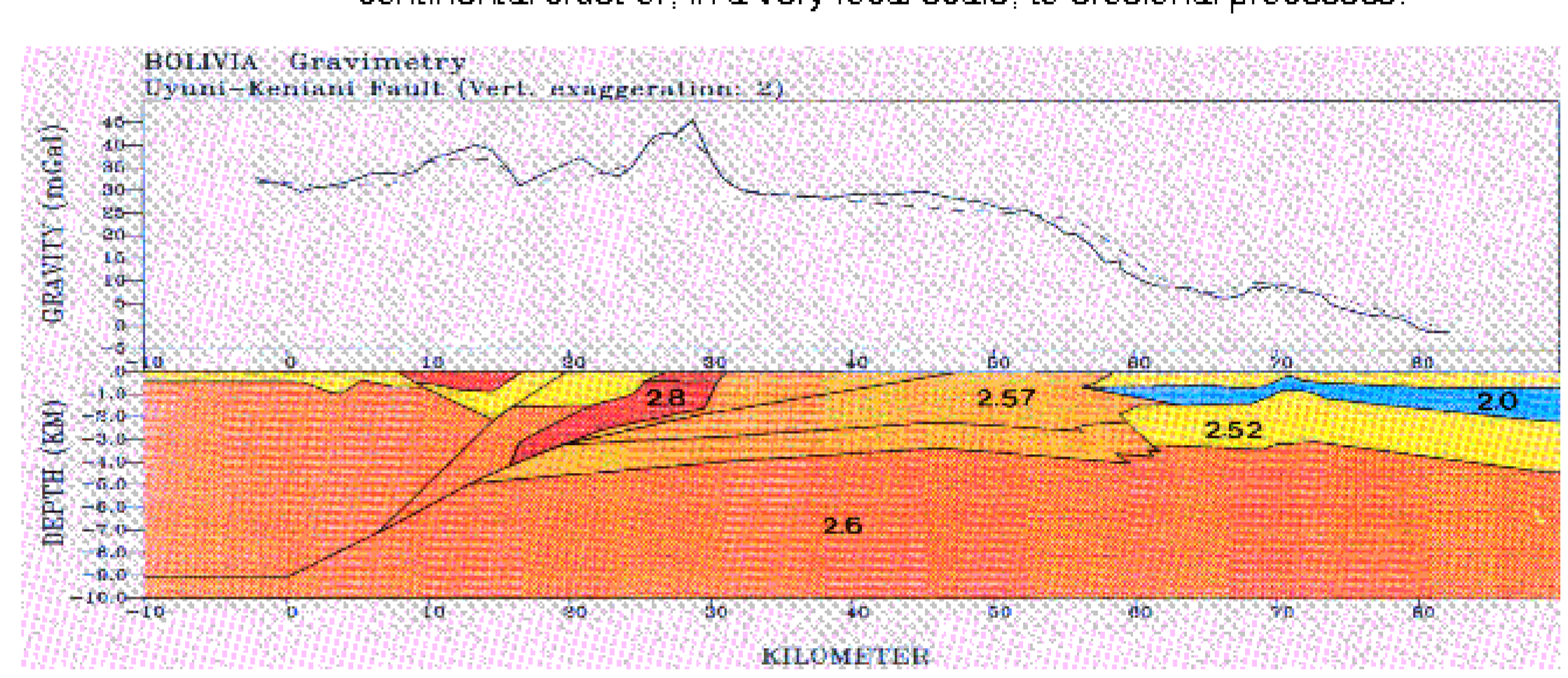

Residual gravity and topography

SFB 267, Task group C6, Jan. '00

### Topography and isostatic residual

The residual gravity field was put on topography. It is shown together with some cities for better orientation (perspective view from the southeast). Surprisingly, all gravity highs of shorter wavelengths in the area of the CAGH correspond to topographic depressions in the Salar de Atacama, Arizaro and Pipanaco to the SE. We assume that the dense masses in rather shallow crustal levels caused subsidence of surface near structures and therefore formed topographic lows.

3D – forward modeling (Diploma Thesis, Choi, 1996), Euler deconvolution, and gravity gradients were combined with seismic modeling (PhD Thesis, Lessel, 1998) and petrological investigations (Palma et. al. 1988; Lucassen et al., 1999; Franz and Lucassen, 1998) to provide insight into the geometrical structure and density distribution of CAGH. It is caused by domains of higher Vp in levels with max. depths distribution of 15 km. A huge body of higher densities/higher velocities with a NW to SE direction could cause that anomaly. It prompted the recent volcanic arc to step to the east. Combined interpretation supports the idea, that it was formed due to processes in a Pre–Andean time span; whether this anomaly is caused by relicts of an old suture or by a suspect terrane is still under discussion.




For the Southern Altiplano of Bolivia we are planing to conduct more 3D–modeling together with task group members working on the structural geology (TG C1). Under the framework of an earlier contract with YPFB some forward modeling has been done to combine results from industry seismic reflection lines and borehole data. This figure shows a bi–dimensional model crossing the Kenyani – Uyuni fault zone. The model is constrained by seismic reflection data and the borehole Vilques.