3D GEOMETRY OF THE SEDIMENTARY INFILL IN THE GUADIX BASIN (S SPAIN): CONSTRAIN ON THE FAULT ACTIVITY

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Introduction

The study area comprises the southern sector of the Guadix Basin (**Fig. 1**), an **intramontane basin located at the boundary between the Internal and External Zones of the central Betic Cordillera** (S Spain). The basin is surrounded by the reliefs of Sierra Nevada towards the S-SW and Sierra de los Filabres towards the E, two large antiforms developed due to the NW-SE to N-S regional convergence between the Eurasian and African plates since the Serravallian-lower Tortonian. Since the latest Miocene, and linked to the progressive relief uplift, the basin was continentalized.

The sedimentary infill of the basin is mainly constituted, from bottom to top, by Serravallian-lower Tortonian continental to deltaic conglomerates, Tortonian marine calcarenites and marls, and latest Tortonian to Quaternary continental sandstones and conglomerates (*Soria et al., 1998*). Its basement is formed by metamorphic rocks (schist, quartzites and marbles, among others) belonging to the Internal Zones. **The area is mainly deformed by NW-SE normal faults** (**Fig. 2**; *Sanz de Galdeano et al., 2012*).

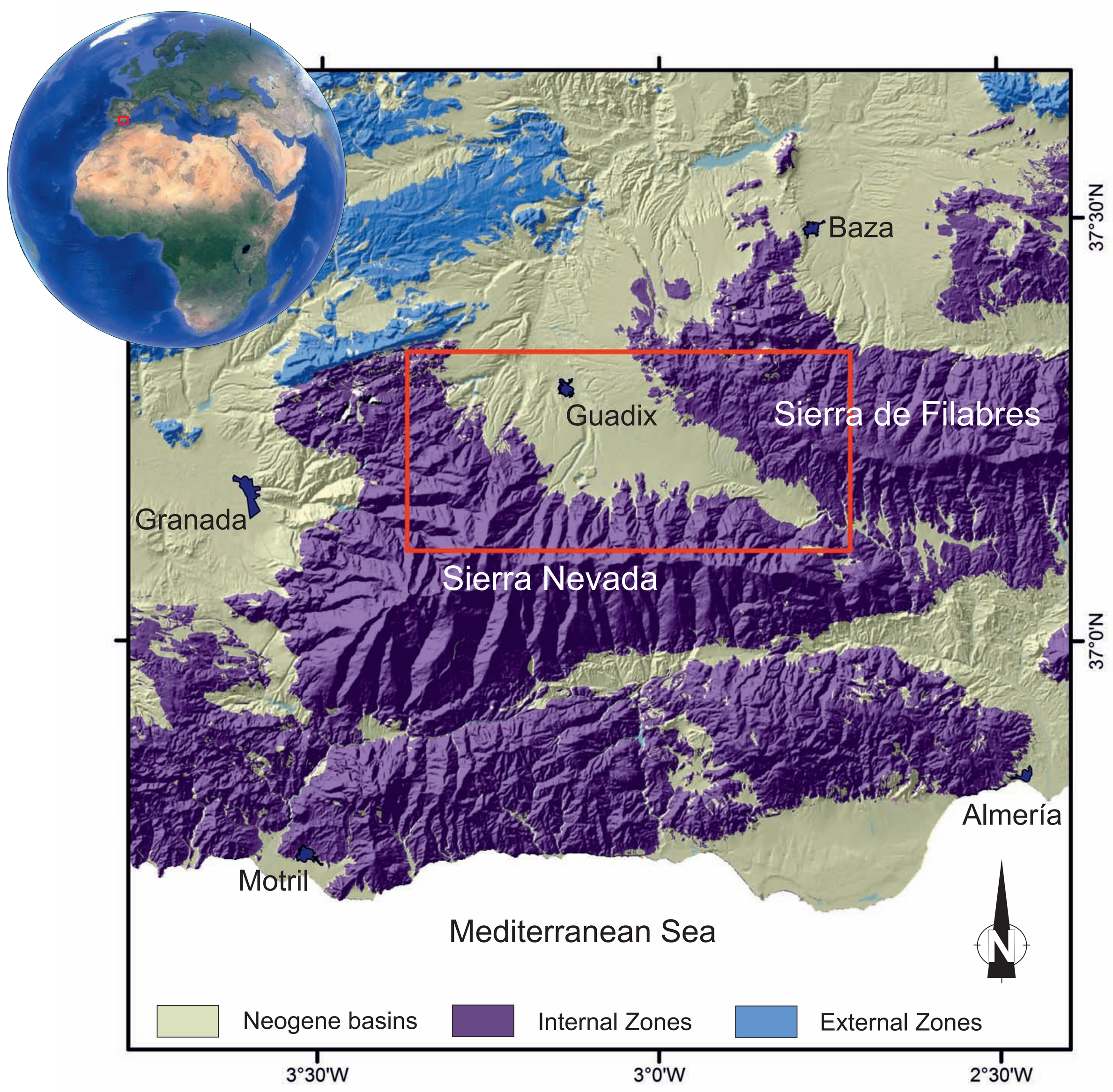

Figure 1 – Location of the study area in the geological context of the Betic Cordillera.

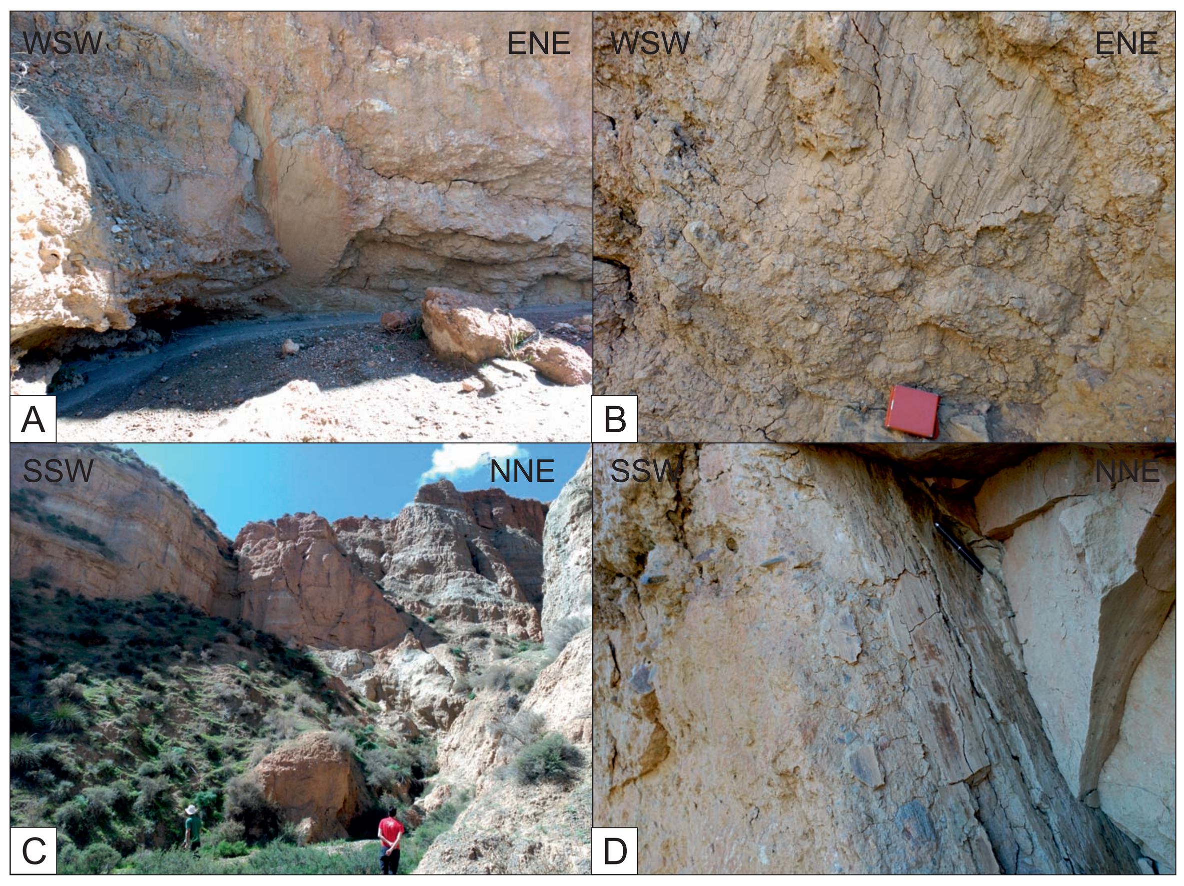

Figure 2 – Field example of faults developed in the Guadix Basin. (A) NNW-SSE high-angle normal fault in the central sector of the basin. (B) Detail of the striation. (C) Normal ESE-WNW fault in the eastern sector(D) Detail of the striation.

Methodology

A 3D geological model was built to determine the deep structure of the southern part of the Guadix Basin (1500 km^2), using 3D GeoModeller and GOCAD codes. The procedure comprises two phases:

i) **development of an initial model integrating all the geological and geophysical information** (geological mapping, structural data, 319 lithological columns of boreholes, 348 vertical electrical soundings, 3 electric tomographies and 17 time-domain electromagnetic soundings) along with new structural data (**Fig. 3**).

ii) **refinement of the model based on the 3D gravimetric inversion** that provides additional information in areas lacking borehole data.

The topographic surface was extracted from the 5 m Digital Elevation Model (DEM) of the Spanish Instituto Geográfico Nacional (http://www.ign.es/ign/layoutIn/modeloDigitalTerreno.do). The lithological contacts and faults were set (digitized and georeferenced) from previous geological maps and locally modified after field work and photo interpretation.

The 3D gravimetric inversion was accomplished using 3D Geomodeller. A total of 714 gravity stations (*Sanz de Galdeano et al., 2007*) were processed to calculate the Bouguer anomaly, with a reduction density of 2.67 g/cm^3 and using the GRS67 Geodetic Reference System. The density value assigned to the basin infill (2.30 g/cm^3) was determined through a 3D gravimetric inversion of the central part of the studied area, were the model geometry was accurately established through boreholes.

The residual anomaly, obtained after the removal of the regional anomaly, was modelled and allowed us **to stablish the thickness of the sedimentary infill**, to test the initial 3D model, and to refine it in areas where the borehole and geophysical data coverage was sparse (**Fig. 4**).

Data	Type	Description
Surface	Geological mapping	MAGNA: 992, 993, 994, 1010, 1011, 1012, 1027, 1028, 1029. Field work
	Structural data	Kinematic fault-slip data
	MDT	MDT (5x5 m)
Subsurface	Boreholes	319
	SEVs	348
	TDEMs	17
	Electric tomography	3 sections
	Gravity data	714 stations

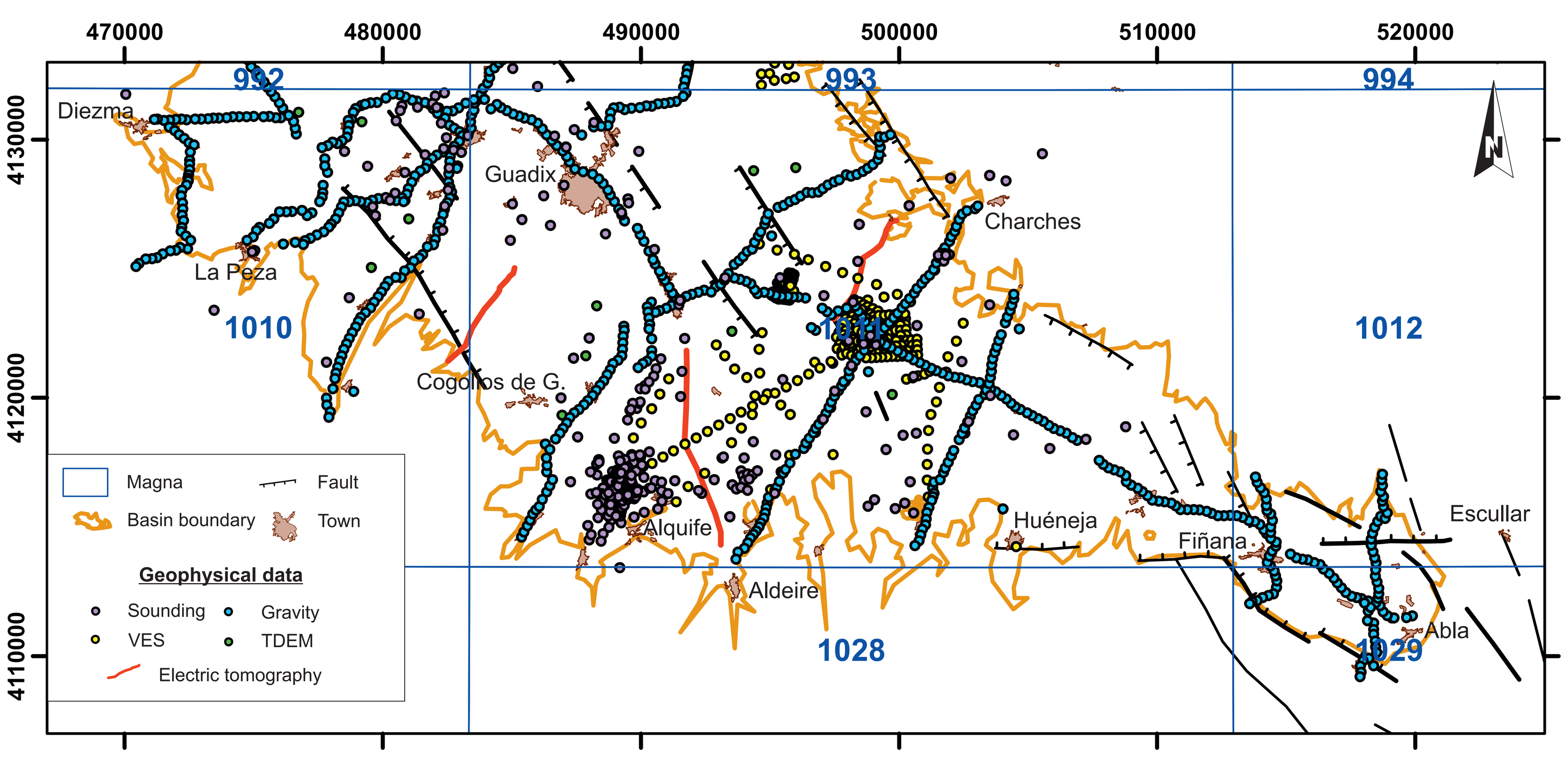

Figure 3 – Spatial distribution of the geological and geophysical data used in the 3D model

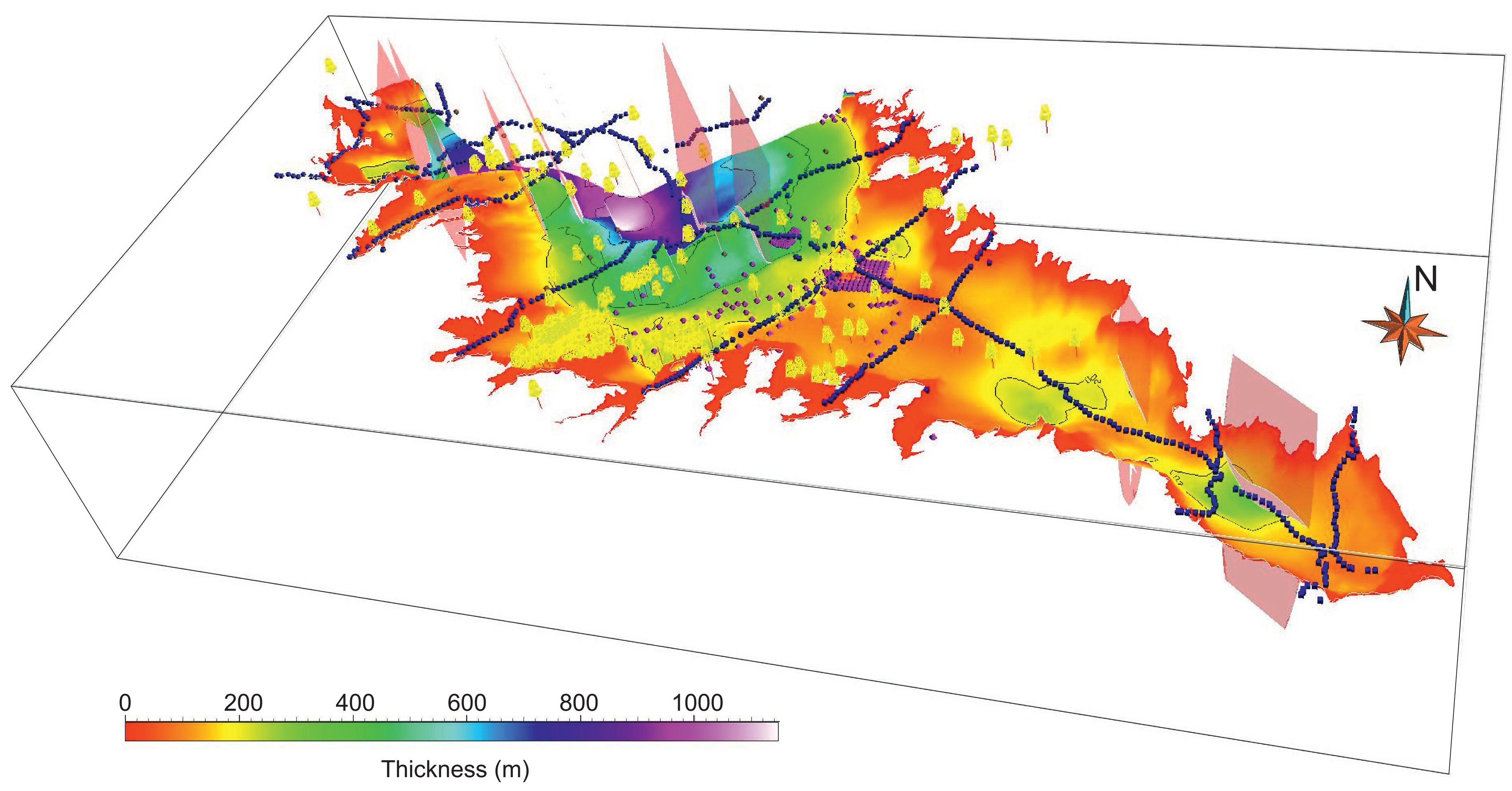

Figure 4 – 3D block diagram of the bottom surface of the Guadix Basin sedimentary infill. Red surfaces correspond to the modelled faults; Boreholes (yellow derricks), gravity stations (blue cubes), vertical electrical soundings (pink diamond) and time-domain electromagnètics (brown diamonds) are represented. The geographical location of the block diagram is indicated in Figure 1.

Conclusions

The main basin depocentre is located at the central sector of the basin with a **maximum thickness of up to 1100 meters**. Its geometry is controlled by NW-SE normal faults to the north meanwhile its southern boundary is gradual.

There is another **depocentre less pronounced (~300 metres) at the southeastern end** of the basin also related to the presence of NW-SE normal faults. Both depocentres are separated by a basement high in the central sector of the modelled area, where the basin only has around 150 meters of sedimentary infill.

The basemet top is offset for hundreds of metres along the NW-SE normal faults. Faults offset is reduced to ten of meters at surface, using upper Quaternary layers as deformation marker. This fact indicates that:

(i) the faults were mostly developed during the sedimentation of the basin
(ii) they were active up to Quaternary times.

Acknowledgements

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References

SANZ DE GALDEANO C., DELGADO, J., GALINDO-ZALDÍVAR, J., MARIN, C., ALFARO, P. y GARCÍA TORTOSA, F.J. (2007) - Principales rasgos geológicos deducidos a partir de los mapas gravimétricos de la cuenca de Guadix-Baza. In: La cuenca de Guadix-Baza. Estructura, tectónica activa, sismicidad, geomorfología y dataciones existentes. Eds. Sanz de Galdeano, C. y Peláez, J.A., Granada, pp 101-110.

SORIA J.M., VISERAS C., FERNÁNDEZ, J. (1998) - Late Miocene-Pleistocene tectono-sedimentary evolution and subsidence history of the central Betic Cordillera (Spain): a case study in the Guadix intramontane basin. Geol Mag, 135,565–574.

SANZ DE GALDEANO C., GARCÍA TORTOSA F.J., PELÁEZ J.A., ALFARO P., AZAÑÓN J.M., GALINDO-ZALDÍVAR J., LÓPEZ CASADO C., LÓPEZ GARRIDO A.C., RODRÍGUEZ FERNÁNDEZ J., and RUANO P. (2012) - Main active faults in the Granada and Guadix-Baza Basins (Betic Cordillera). Journal of Iberian Geology, 38, 209-223.