IX CONGRESO GEOLOGICO CHILENO

31 Julio – 4 Agosto, 2000
Puerto Varas • Chile

ACTAS • VOL. 2
SIMPOSIO NACIONAL N° 5
Páginas 434 • 437

REFLECTION SEISMIC AND GEOLOGICAL DATA IN A CENTRAL SECTOR OF THE SARDINIAN RIFT (WESTERN MEDITERRANEAN)

Fais, S.[1], Lecca L.[2] y Tocco, R.[3]

INTRODUCTION

Through the integrated analysis of seismic reflection and land geological data, the geostructural study of the set of tectonic fossae that involved the Sardinian Block during the evolution of the basins of the Western Mediterranean in the Oligo-Miocene and their extensional reactivation related to the Tyrrhenian opening in the Late Miocene-Pliocene, is developing. The main tectonic structure generated in the Oligo-Miocene phase is represented by the N-S trending Sardinian Rift, which is segmented by E-W and NE-SW transversal structures. Along these structures a number of minor basins, which were filled by very thick volcanic products and continental and marine sedimentary successions, developed (2,3). Recently, the Rift structure has been analysed through the study of its individual basins, with the aim of reconstructing in detail the complex structural framework and the genetic mechanisms characterising it. This paper presents the results obtained in the Ottana basin (Central Sardinia), which is one of the most representative sectors of the Sardinian Rift.

GEOLOGICAL AND SEISMIC DATA

The Ottana Basin, as well as the other basins of the Sardinian Rift, evolved during the Oligo-Miocene geodynamic phase that caused the opening of the Western Mediterranean and the Maghrebian and Apennine orogenies. The regional deformation mechanism that would have caused the propagation of transtension-extension zones, associated with calcalkaline andesitic and ignimbritic type volcanism, may be attributed to an indentation between North Africa and a palaeo-promontory of the Iberian Plate that included the Sardinian-Corsican Block. During this geodynamic phase, Sardinia was involved by block transtension-extension tectonics, which gave rise to a basin system in both continental and marine environments, currently called Oligo-Miocene Sardinian Rift (3). Within these tectonics, the Ottana Basin is a direct consequence of the relative displacements between the crustal block of central Sardinia and that of Marghine-Logudoro along two main fault zones: the Silanus-Benetutti zone to the North, and the Nuoro zone to the South (1).

The horst-blocks are made up of Hercynian granites and metamorphites, covered proximally by a succession of stone ignimbrites and interbedded tuffs and epiclastites. In the literature the basin is called a graben (4). Based on land data, it is acknowledged that the upper part of the filling sequence of the graben is made up of an Early-Middle Miocene succession of cineritic-pomiceous pyroclastic banks, volcanic epiclastites, and alluvial conglomeratic sandstones. A silicoclastic-carbonatic continental shelf marine sequence is present only in the uppermost part of the filling succession. Basalt lava flows and Plio-continental conglomerates cover the oldest units.

To acquire new elements on the stratigraphy and tectonic layout, five reflection seismic profiles were performed in the innermost part of this basin for up to about 13 kilometres. In the early phase two profiles were carried out in the north-eastern sector of the basin (lines 1 and 2; (2)); subsequently lines 3 and 4 respectively with a NE-SW and a NNW-SSE orientation, located in the central sector of the basin between Bolotana and Ottana and line 5 in the sector further south, were carried out. Thanks to Lines 1, 2, 4, and 5, it has been possible to reconstruct one N-S section, transversal to the basin and about ten kilometres long.

In order to select the acquisition parameters, preliminary field tests were carried out aimed prevalently at determining the offset, spread type, etc.

[1] Dipartimento di Geoingegneria e Tecnologie Ambientali, Universita' degli Studi di Cagliari, Italy.
[2] Dipartimento di Scienze della Terra, Universita' degli Studi di Cagliari, Italy.
[3]. Vico Assab, Quartucciu, Cagliari (Italy).

Data processing was of the conventional type. The following were the main operations:

Demultiplex
Beam stearing
Sort into cdp order
Gain recovery and predictive deconvolution
FK Filtering
NMO application and mute
Residual Statics
FX deconvolution
2D Powering
Equalization

The results obtained with the above processing sequence are seismic sections that were also interpreted using the respective displays of the instantaneous phase. As an example, Figures 1 and 2 shows the displays relating to lines 1, 2, and 4. Two zones can be clearly distinguished in the seismic sections: one is on average within the first second (of a depth of about 1500 metres), where different sub-parallel reflection sequences can be recognized; in the other zone, below, the reflection configuration is chaotic and is characterised by the presence of discontinuous signals at times of a large amplitude, suggesting the typical intense deformation of the Paleozoic basement.

On the other hand, the sub-parallel reflection zone can be distinguished in a number of units, often discordant among themselves, with homogeneous internal seismic characteristics. In the southern part of the section, near lines 4 and 5, a significant structural high, which is contemporaneous with the two main faults and which raises the Paleozoic basement and the overlying series, is observed. Subsequently, due to the displacement along the Nuoro fault, a second basin was formed, with thickening of the Mio-Pliocene units.

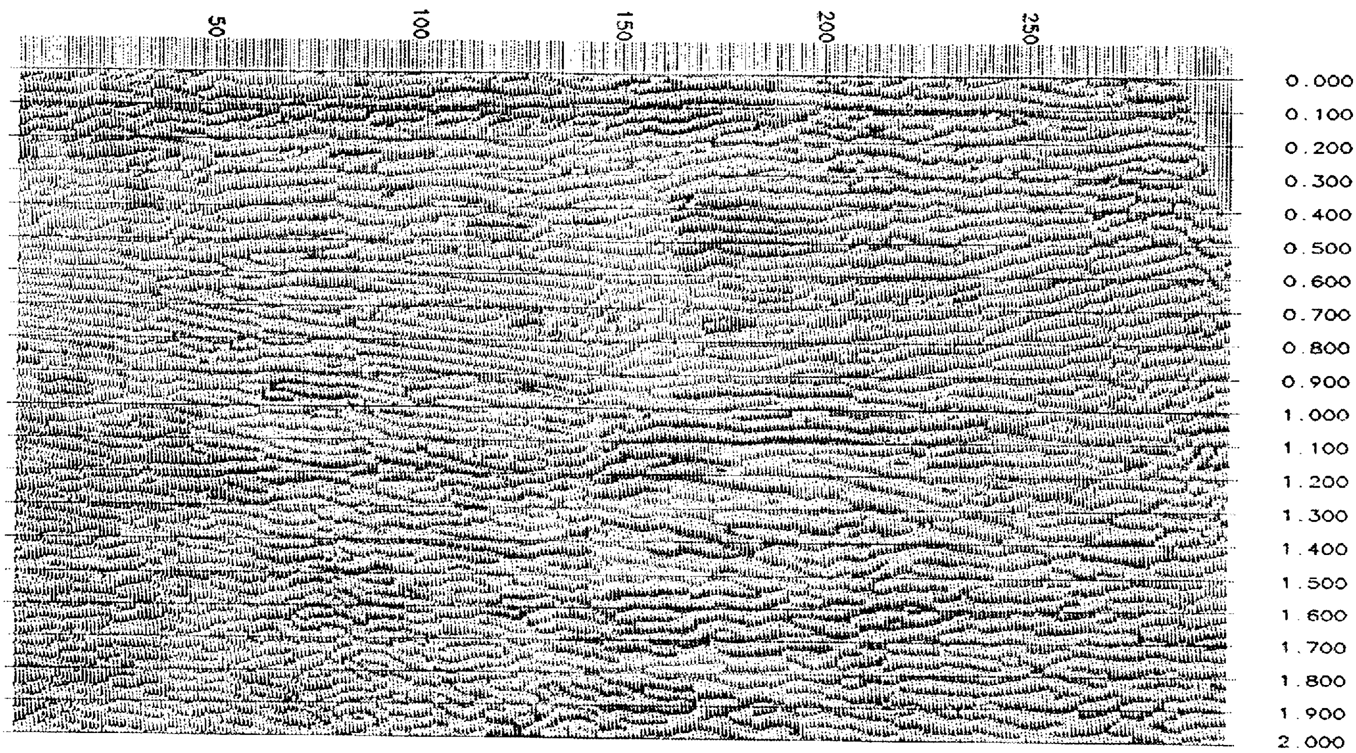

Fig. 1. Instantaneous phase display corresponding to the sections 1 and 2, from De Cillia *et al.*, 1992.

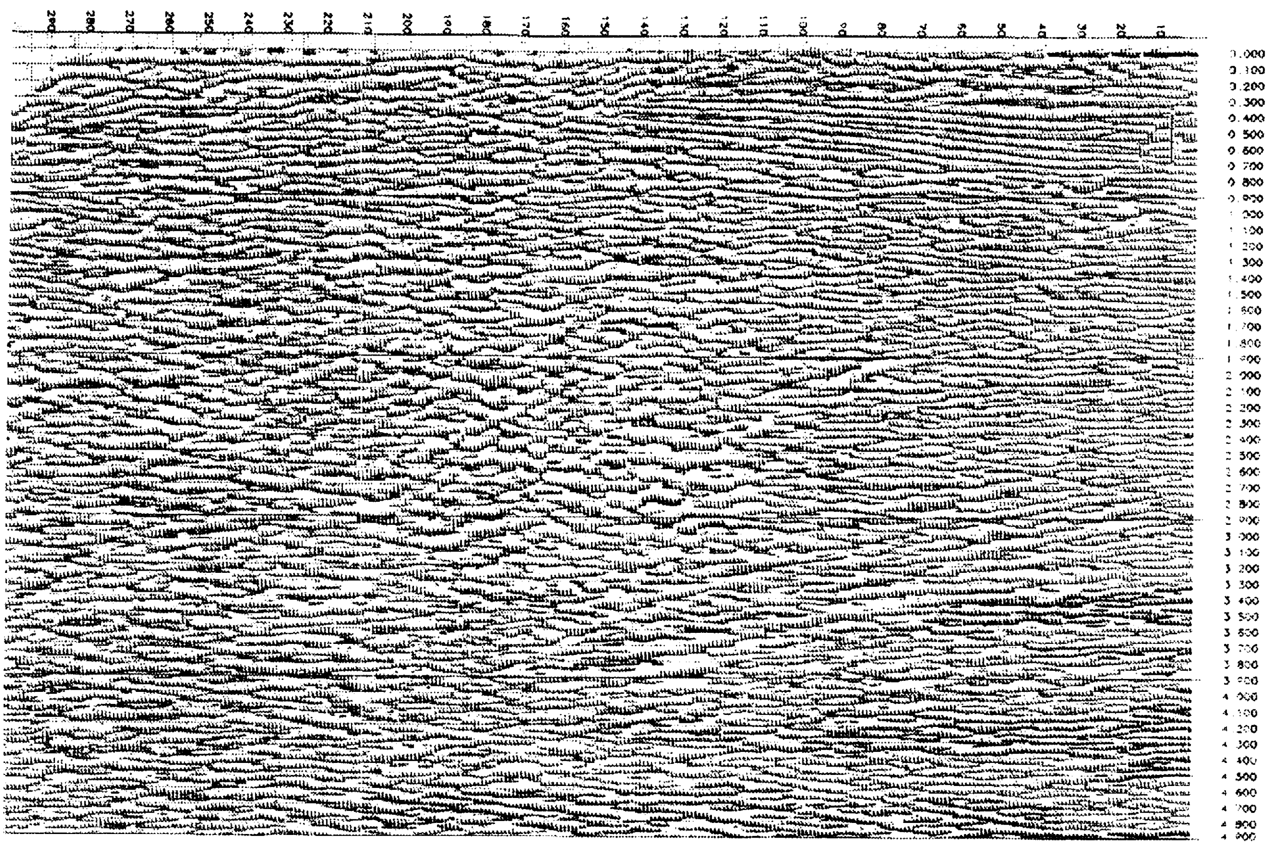

Fig. 2. Instantaneous phase display corresponding to the section 4.

CONCLUSIONS

The interpretation of the seismic data has allowed to define the structural sketch of the NE sector of the Ottana basin, which is made up of two sub-basins: a larger one of Oligo-Miocenic age, located in the northern part of the study area, and a smaller sub-basin located in the southern part, that is of a later age, of the Lower-Middle Miocene.

Based on seismic and geological data, the very thick ignimbrites that were found in depth within the Northern sub-basin can be referred to the Oligo-Miocenic structuring at the time of the opening of the Western Mediterranean. Probably this tectonic event, in transtension, reactivated Hercynian crustal structures that had already been reactivated during the Mesozoic and the Palaeogene.

The larger thicknesses of the more recent filling sequences, observed along line 5 in the southern sub-basin, are due to increasingly extensional movements that could have intensified phenomena subsidence. The continental conglomerates and the basaltic plateau outcropping west of the seismic line and covering the older units, are evidence of further extensional reactivation at the time of the Plio-Quaternary opening of the Tyrrhenian Basin.

From the interpretation of the seismic data, it has emerged that some evolutionary stages of the Sardinian Rift, not recognisable from surface geological data, are present within the Ottana Basin.

ACKNOWLEDGEMENTS

This research was carried out with the financial support of the MURST (Italian Ministry for the University and Scientific and Technological Research) (ex 40%-Cofin98' funding)

REFERENCES

1. Assorgia, A.; Balogk, K.; Lecca, L.; Ibba, A.; Porcu, A.; Secchi, F.; Tilocca, G. 1995. Volcanological characters and structural context of Oligo-Miocene volcanic succession from Central Sardinia (Italy). Acc.Naz.delle Sc.,XL,XIV, (Rapporti Alpi-Appennino),1994, 397-424.
2. De Cillia C.; Fais S.; Porcu A.; Tocco R. 1992. Geostructural features of the middle Tirso valley from seismic reflection data. Boll. Geof. Teor. Appl. 136, 273-286.
3. Lecca, L.; Lonis R.; Luxoro, S.; Melis, E.; Sechi, F.; Brotzu P. 1997. The volcanic stratigraphy and Oligo-Miocene rifting stages in Sardinia: a review. Per. Mineral., 66, 7-61.
4. Porcu, A. 1983. Geologia del Graben di Ottana (Sardegna centrale) Rend. Sem. Fac. Sc. 53, 151-169.