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APPLICATIONS AND IMPLICATIONS OF HIGH RESOLUTION GRAVITY DATA IN THE BLOCK NC190, MURZUQ BASIN, LIBYA

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Repsol-YPF is operating the exploration concession NC190 located in the Murzuq basin, Libya. The area of the block NC190 is about 12,300 Km^2 and has a coverage of 1200 kilometres of 2D seismic data, acquired by Repsol-YPF since the year 2000 till now. Two wells have been drilled to date, the first one (A1-NC190) being a discovery well. The area is located to the northeast of the concession NC115 where REPSOL, as operator, is producing an average of 163,000 BOPD.

The main reservoirs in the basin are the Mamuniyat (Ashgill) and the Hawaz (Llandello) formations that were deposited in a high latitude environment characterised by a glacio-eustatic control. The marine Silurian shales provide the seal and source rock.

A high definition gravity survey with 6232 independent gravity stations arranged in an equilateral triangular grid of side 1.7 km was acquired in the NC190 block during the spring of 2001. The geological objectives were to delineate top basement depth and to locate any large local traps formed by relief on the base of the seal, the Tanezzuft shale. To achieve the last objective, the final Bouguer gravity data were modelled so that the accuracy is better than 0.1 mGal. This required resolution can be jeopardised by sand dunes up to 100 meters height covering the area with gravity effect calculated using a 20 meter lateral resolution satellite-derived Digital Elevation Model (DEM). Uncertainties in the DEM were the ultimate limiting factor on the precision of the survey, yielding to a final estimated uncertainty a bit lower than 0.1 mGal.

Gravity has proved its utility in reducing risks in areas poorly covered by seismic. Correlation with existing seismic data confirmed the accuracy of the method. Gravity data has been helpful for the design of new seismic acquisition programs, the interpretation of possible traps in the Upper Ordovician (figure 1), and the imaging of the depth of Basement and fault pattern definition (figure 2).

Figure 1 is the map for possible traps at base Tanezzuft. A density contrast of 0.25 g/cm^3 is assumed between Tanezzuft and Hawaz, therefore a 100 m local elevation change in base Tanezzuft should give rise to a 1 mGal anomaly. Effects from shallow basement are removed applying a bandpass filter (20 km 4^{th} order Butterworth high-pass filter combined with a 2.5 km high pass to remove some noise). 100 m/mGal scaling was applied with a sign change to obtain a

speculative picture of base Tanezzuft, freed of regional effects. It must be emphasized that this figure includes all small-scale shallow effects and possible variations in top basement. However it should show all potential major traps at base Tanezzuft.

A seismic section across the Lead 1 demonstrates the good correlation of the gravity anomaly with the seismic data. A Hawaz paleo-high clearly appears in the center of the section at the same location of the gravity feature.

Figure 2 is the Gravity horizontal gradient that highlights structural breaks where there is a sharp lateral density change. Such changes could represent contacts or faults. There is a NW-SE dominant trend of faults validated with seismic. It is also remarkable the presence of several acidic intrusive plugs in the basement which produce circular lows in the Bouguer gravity (features 3, 4 & 5). In the northern most intrusion (feature 3), there is fault control on its emplacement. Structural breaks are also displayed in figure 2. They could mark changes in structural style. Break 1 could be a major E-W fault with down-throw to the south. Break 2 is a subtle linear trending ENE of nature not clear. There appear to be fabric changes across it, and it seems to show normal movement down to the north in the east of the area and down to the south in the west. It seems to be an old fault that has been multiply reactivated.

Due to the good correlation between seismic and gravity, we can be highly confident about the presence of faults and breaks in areas where they appear to be on the gravity map but there is not seismic coverage available. The presence of possible traps in the Upper Ordovician identified on gravity and checked on seismic, adds more prospectivity to the block guiding for future exploration. It can be affirmed that gravity is a powerful tool that helps in the identification of prospective Ordovician palaeo-highs in the block NC190.

Figure 1: Possible Traps at the Base Tanezzuft from Gravity

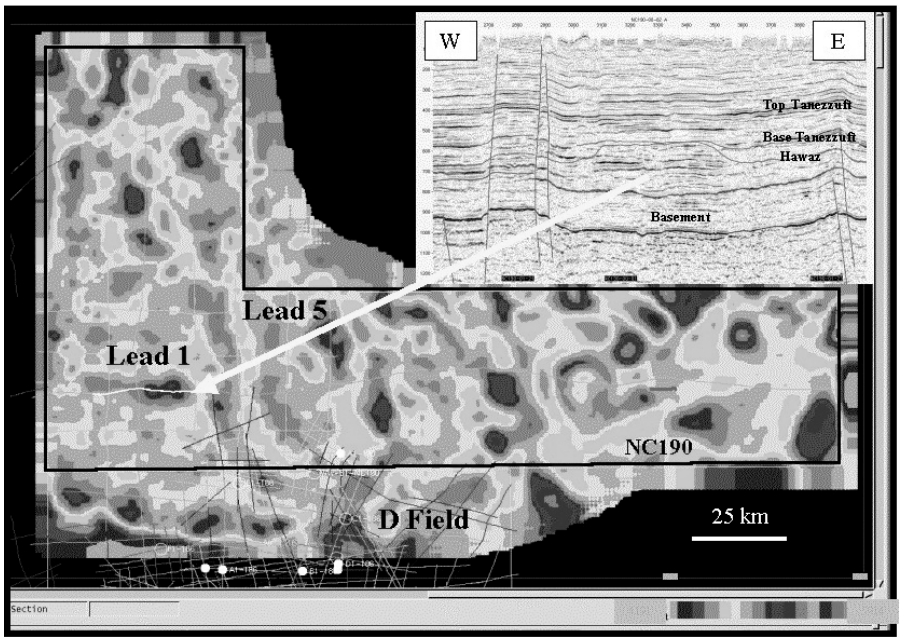

Figure 2: Gravity Horizontal Gradient (microGal/Km)