Reservoir and Seal Potential in a Young Oceanic Basin: The Vavilov Basin (Central Tyrrhenian Sea)*

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Search and Discovery Article #50546 (2012)
Posted January 30, 2012

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*Adapted from poster presentation at AAPG International Conference and Exhibition, Milan, Italy, October 23-26, 2011

Abstract

The Vavilov basin is a young oceanic basin floored with ~ 4 Ma oceanic crust, average depth is 3,500 m, and it is bounded to the North, West and East by several seamounts and structural ridges, with variable heights above the seafloor. The Vavilov submarine volcano, laying at the center of the homonymous basin, together with a structural ridge, separate the basin into two sub-basins from North to South, the Gortani and Magnaghi basins. Multibeam bathymetry, 450 Nm of CHIRP profiles, single-channel seismic and sparker profiles, 3 long gravity cores are available over the study area.

Geophysical and geological data allow to constrain the presence of 4 acoustic transparent layers (ATLs) intercalated with turbiditic layers. The average thickness of the ATLs is 20 m, but varies from a few meters to 50 m; turbidite thickness varies from 10 to 30 m. The ATLs pinch out against the basin bounding structural highs and have two distinct depocenters in the eastern and western portions of the Gortani basin. The ATLs are composed of fine grained sediment. Active faulting is also evident in the CHIRP profiles, with seafloor steps offsetting the whole sedimentary sequence. ATLs may be interpreted as mass-transport deposits emplaced during regional seismic events and being the result of instant and quick discharge of fine grained sediment. As a consequence, a large variety of relationships between sand-prone turbidite units and clay-rich sealing debrites is to be expected: sandy turbidite units with thickness up to 30 m and with a large lateral extent sandwiched between debrite deposits; narrow channelized portion of debrites with steep margins; basal erosional surface of the debrites with or without lateral conformable wings above the turbidites.

In conclusion, the uneven bathymetry due to the opening of the central Tyrrhenian Sea, the presence of volcanoes and other confining topographic elements show a variety of potential reservoir geometries and possible input for modeling applications: geometry of pinch-out and flow behavior; slope angle of bounding escarpment; classification of the structural high confinement; source area and geometry of basinal depositional units.
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The Vavilov basin is a young oceanic basin formed with 3-4 Ma oceanic crust (Fig. 1a) in the North Tyrrhenian Sea. The basin is bounded by several seamounts and structure ridges, with variable heights above the seafloor. The tectonic evolution is strongly linked to the southern and to the eastern Gondwana and, together with the Gondwana ridge, separate the basin into two sub-basins: the western Gondwana (WGB) and the eastern Gondwana basin (EGB). Fig. 1a shows the bathymetry of the basin. The basin is characterized by a maximum depth of 3.500 m and is bounded to the North, West and East by the Gondwana ridge. The basin is fed by the Alboran and Algerian currents, which transport sediments from the Spanish margin to the Vavilov basin. The basin is also influenced by the East Tyrrhenian Current, which transports sediments from the North Tyrrhenian Sea to the Vavilov basin. The basin is characterized by a maximum depth of 3.500 m and is bounded to the North, West and East by the Gondwana ridge. The basin is fed by the Alboran and Algerian currents, which transport sediments from the Spanish margin to the Vavilov basin. The basin is also influenced by the East Tyrrhenian Current, which transports sediments from the North Tyrrhenian Sea to the Vavilov basin.

Fig. 2 Depositional distribution of ATL1
Mean thickness: 2.6 m
Area: 3775 km²
Volume: 7.8 km³

Fig. 3 Depositional distribution of ATL2
Mean thickness: 1.5 m
Area: 4525 km²
Volume: 4.5 km³

Fig. 4 Depositional distribution of TORB
Mean thickness: 7.6 m
Area: 3775 km²
Volume: 16.4 km³

Fig. 5 Depositional distribution of ATL3
Mean thickness: 4.4 m
Area: 3775 km²
Volume: 62.4 km³

Fig. 6 Depositional distribution of ATL4
Mean thickness: 16.3 m
Area: 3775 km²
Volume: 16.4 km³

The cumulative average thickness of the 4 ATLs varies from being below the resolution of the data to one meter to 30 m. TORB unit thickness varies from 1 to 15 m. All the units show principal seismostratigraphic units in the western and eastern area of the basin (Fig. 6, 7, 8, 9). The ATLs and TORB unit are arranged in several depocentres (Figs. 6-9) and can be described as turbidite units within a modern confined system.

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