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Drake Passage: crustal structure, tectonic evolution and new prognosis for local HC accumulations along the Antarctic Peninsula margin

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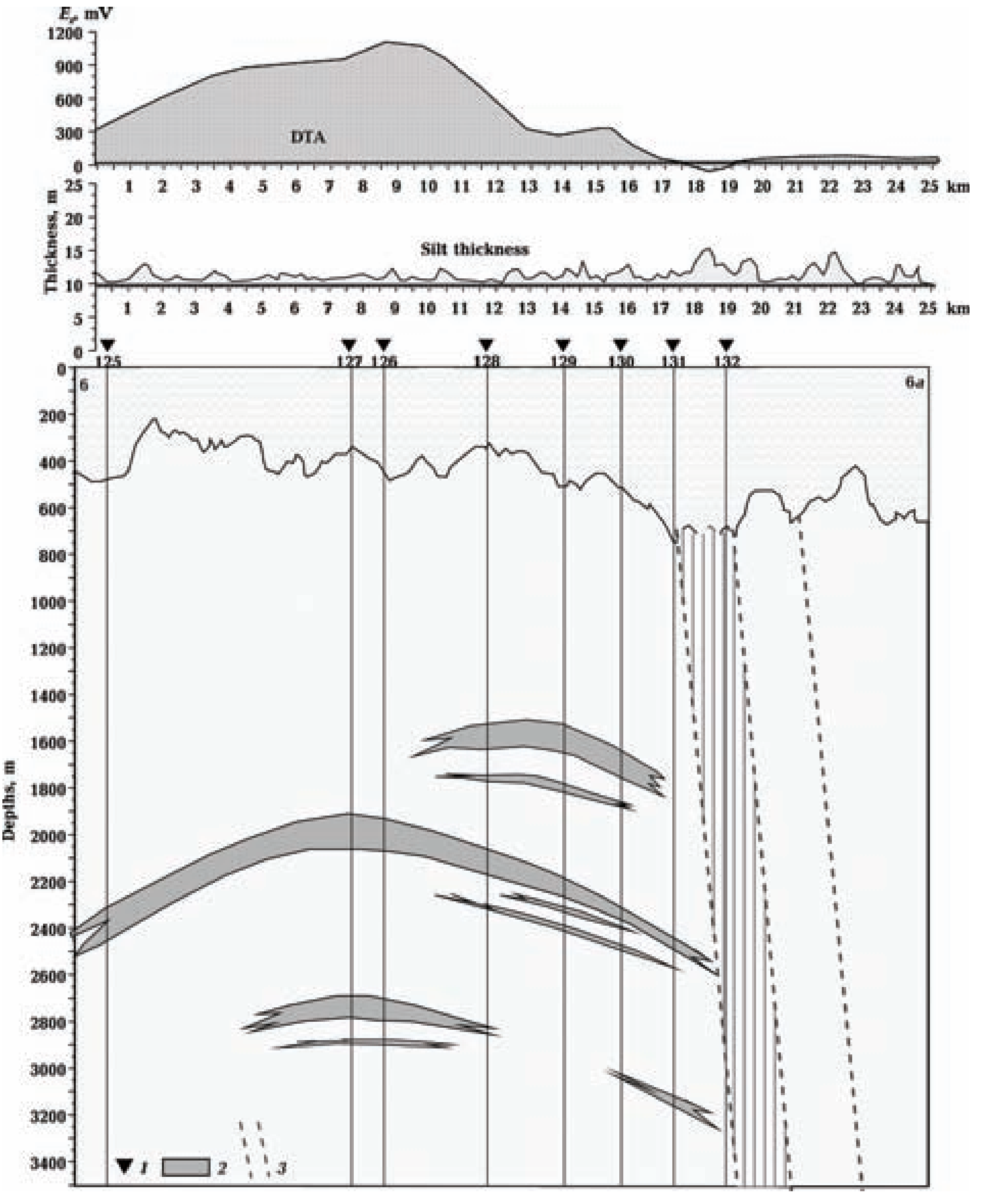
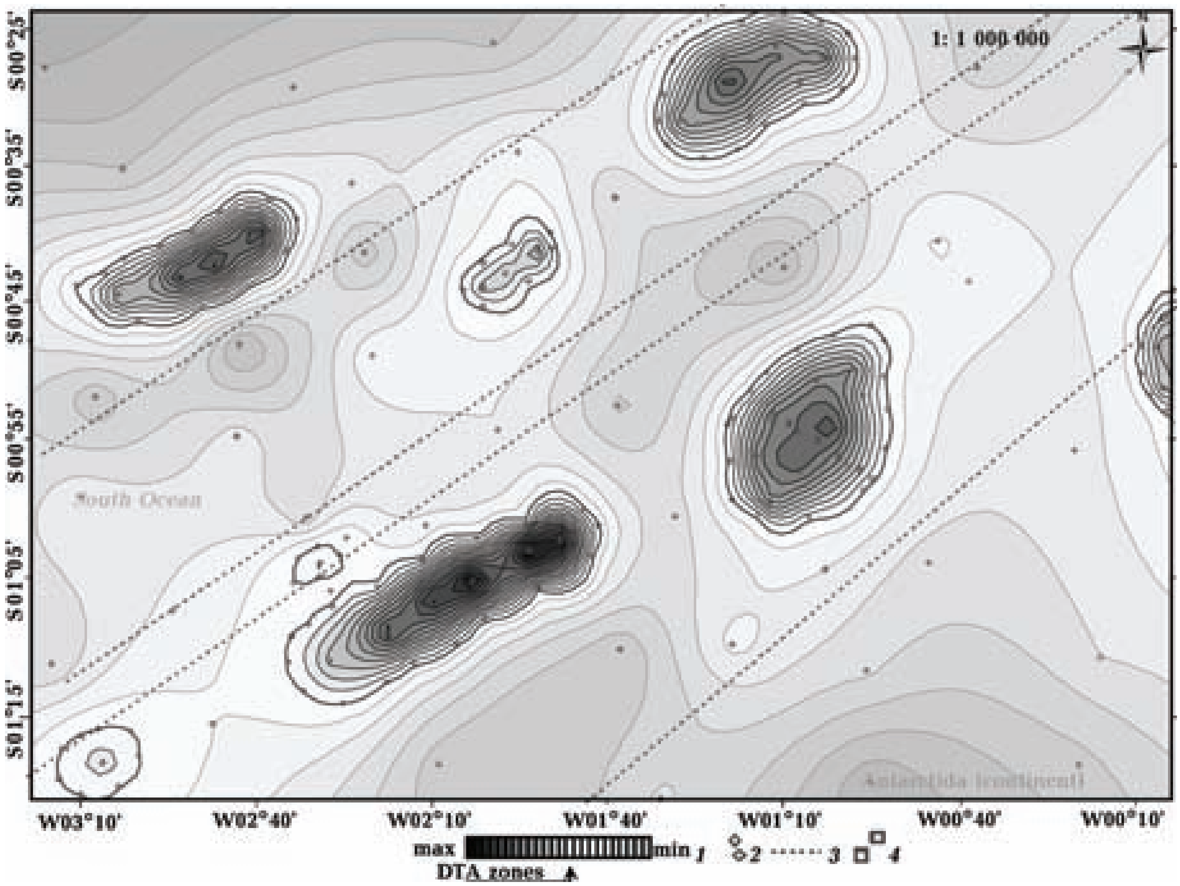
New geological and geophysical data that have been obtained during last years for bottom structures of West Antarctica are of particular importance for evolution and geodynamics processes of this region understanding. The 2004 (9^{th}) and 2006 (11^{th}) Ukrainian Antarctic expeditions acquired new geo-



a

The VERS sounding data and geoelectric anomalous zone of the “hydrocarbon deposit” type in the Antarctic Peninsula region (*a*): *1* — the sounding points; *2* — anomalous polarized layers of “hydrocarbon deposit” type; *3* — tectonic fracture zone. Map of anomalous zones of «oil deposit” type in the Antarctic region (relative coordinates, near Ukrainian Antarctic Station «Academician Vernadsky»), allocated by the satellite data special processing and interpretation results (*b*): *1* — the scale of the anomalous response intensity; *2* — points of the anomalous response values determination; *3* — predicted tectonic fractures; *4* — points of «deposit» type anomalies by geoelectric methods FSPEF and VERS.



b

electrical data ('short-impulse electromagnetic field formation' — FSPEF, and 'vertical electric-resonance sounding' — VERS) along profiles across Drake Passage with the aim of studying the crustal structure down to depths of >30 km. Obtained crustal inhomogeneities could be connected with some evolution stages of tectonic and magmatic processes at this region — the fluid regime, tectonic disturbances and crush zones in basement and local places of submarine volcanic activity too [Levashov et al., 2006; Drake …, 2007]. Analysis has been provided new data of the sedimentary horizons deep structure and Moho crust-mantle discontinuity of Drake Passage. Beneath the Drake Passage, Moho is interpreted at shallow depths of 8—12 km and more. Both Moho and the deeper layer show strong variations in depth and thickness in the vicinity of the Shackleton Fracture Zone (SFZ). It's forming was connected with episodes of Drake Passage opening, which led to the final separation of the South America and Antarctic continents. The trough system near this zone was formed when stress field regime was extensional and local rifting and spreading processes had been developed. SFZ is characterized by thickened oceanic crust, deformed by deep local faults, which cut across layers 2 and 3 of the oceanic crust.

The gravity models show in detail the deep structure of the fracture zone and suggest that crustal thickness remains approximately constant along SFZ, whereas central valley of rifted West Scotia Ridge shows crustal thinning. Obtained results assure the no Table role of continental fragments (extending from the northwestern Antarctic Peninsula towards the Pacific margin of the south-western top of South America) in crustal structural transformations and rifting processes at the central part of Drake Passage. As oil and gas exploration activities are focused along continental margins, where fragmenting and presumably petroleum deposit formation has taken place, the FSPEF and VERS geoelectric methods were used also in Antarctic expeditions for the hydrocarbon (HC) resources prospecting along the Antarctic Peninsula margin. During the expedition one «deposit» type anomaly was mapped by FSPEF survey in area not far from the Ukrainian Antarctic Station «Academician Vernadsky» [Drake …, 2007]. Some anomalous polarized layers of «oil deposit» type were mapped by VERS sounding in depth interval up to 3500 m. (Figure, *a*).

The special method of satellite data processing and interpretation for this anomaly region was applied. Four relatively large anomalous zones of «oil deposit» type were identified and mapped within the surveyed segment of the Antarctic Peninsula margin. The mapped (during 2006 expedition) geoelectric anomaly of «oil deposit» type completely falls into one of the anomalous zones that were selected by satellite data (Figure, *b*).

The multi-channel seismic data acquired on the South Shetland margin [Jin et al., 2003] show that Bottom Simulating Reflectors (BSRs) are widespread in the area, implying large volumes of gas hydrates. Satellite data over the site of BSR zones extension, identified by seismic studies, have been processed and interpreted. The various processing parameters were analyzed during investigation that allowed revealing and mapping the anomalous zone of «gas hydrates deposit» type within this region. In general, the revealed and mapped anomalous zone of «gas hydrates deposit» type satisfactorily correlate with BSRs zones, defined by seismic data. The anomalous zones of «gas deposit» and «oil deposit» type were not detected there by the satellite data processing and interpretation results.

Conclusions. New data about geodynamics and Drake Passage earth's crust structure have demonstrated high efficiency of the VERS method using. New prognosis for local HC accumulations along the Antarctic Peninsula margin confirms the high oil and gas potential perspectives of the Antarctic Peninsula region.

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Numerical modeling of cloud and precipitation evolution and its connection with entropy

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A recent work devoted to sources of entropy connected with mesoscale frontal cloudiness. Three-dimensional nowacasting and forecasting numerical models developed in UHRI [Pirnach, 1998; 2008; Belyi et al., 2009] for modeling of the winter and summer frontal cloud systems were adapted for theoretical interpretation of the investigated phenomena.

The integration of full thermodynamic equations, which included equations for air motion, water vapor content, temperature transfer, the continuity and thermodynamic state equations are used in these models. Cloud microphysics is considered explicitly by solving the kinetic equations for the droplet and crystal size distribution. The size distribution function of the cloud and precipitation particles is formed due to cloud condensation nucleation, ice nucleation, growth (evaporation) by deposition, and freezing, riming, collection by raindrops of cloud drops. Droplet and ice nucleation is accounted by parameterization in the model. Cartesian coordinates (x, y, z) and terrain-following sigma coordinates ξ, η, ζ have been used. In second case the system of equation will be described as follows:

$$\frac{dS_i}{dt} = F_i + \Delta S_i \,, \qquad (1)$$