
INFORMATION

Geological Investigation of the King's Trough on Expeditions 55 and 57 of the R/V *Akademik Nikolaj Strakhov*

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Abstract—We provide information on geological and geophysical studies of the structure of the King's trough, located on the eastern flank of the Mid-Atlantic Ridge in the North Atlantic Ocean on expeditions 55 and 57 of the R/V *Akademik Nikolaj Strakhov* in 2023 and 2024. Preliminary results of the expeditions are discussed.

Keywords: North Atlantic, oceanic crust, basalts, bathymetric map, anomalous magnetic field, King's trough

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In 2023 and 2024, the Geological Institute, Russian Academy of Sciences, and the Shirshov Institute of Oceanology, Russian Academy of Sciences, conducted two integrated geological and geophysical expeditions aboard the R/V *Akademik Nikolaj Strakhov* (cruises 55 and 57) in the area of the King's Trough, a poorly studied megastructure located in the North Atlantic, under the expeditionary program approved by the Ministry of Science and Education of the Russian Federation.

The main aim of the expeditions was to study the tectonics, magmatism, hydrothermal metamorphism, and sedimentation in the area of the mesostructural cluster formed by the King's Trough, the Azores–Biscay Rise, and the Gnitsevich Plateau on the eastern flank of the Mid-Atlantic Ridge.

The main types of work in both expeditions included detailed bathymetric surveys of the bottom using a SeaBat 7150 multibeam deep-sea echo sounder with a 12 kHz sonar acoustic signal recording mode, seismoacoustic profiling using an EdgeTech 3300 shipboard profiler with a frequency of 2–6 kHz and a Parasound DS Subbottom P-35 parametric acoustic profiler, as well as anomalous magnetic field measurements using Geometrics G882 and SeaPOS2 magnetometers. Rock material was recovered with a dredge.

Volume of works performed. Bathymetric and acoustic profiling at the King's Trough research area in the two expeditions were carried out on 74 tracks with a total length of 15219 km (Fig. 1). Based on continuous bathymetric survey data, a bathymetric map of

a 1 : 100000 scale with an area of 106,339 km² was compiled. Magnetic profiling was carried out on the same tracks. Based on the materials obtained, a map of the anomalous magnetic field was compiled. Thirty-nine dredgings were done (Fig. 1), 26 of which successfully: about 1050 kg of bottom rock material was collected. In transit tracks, bathymetric and acoustic profiling over a length of 4282 km and magnetic profiling over a length of 2490 km were carried out.

PRELIMINARY SCIENTIFIC RESULTS OF THE EXPEDITIONS

(1) Based on the bathymetric mapping results, several morphostructural provinces were identified within the studied King's mesostructural cluster, differing from each other in the nature of their relief. In general, four main geomorphological levels are distinguished in the relief: the bottom of the troughs, which form a system of elongated depressions of northwestern strike, building on each other along the strike and parallel to each other; the surface of the arch, cut by these troughs; the surface of volcanic plateaus growing on the arch; and the tops of cone-shaped volcanic structures, rising above the plateaus.

(2) The flank zones of the King's Trough are complementary: on opposite sides, there are structures close in morphology with similar geomorphological levels, emphasizing their formation as a single structure subsequently separated by troughs.

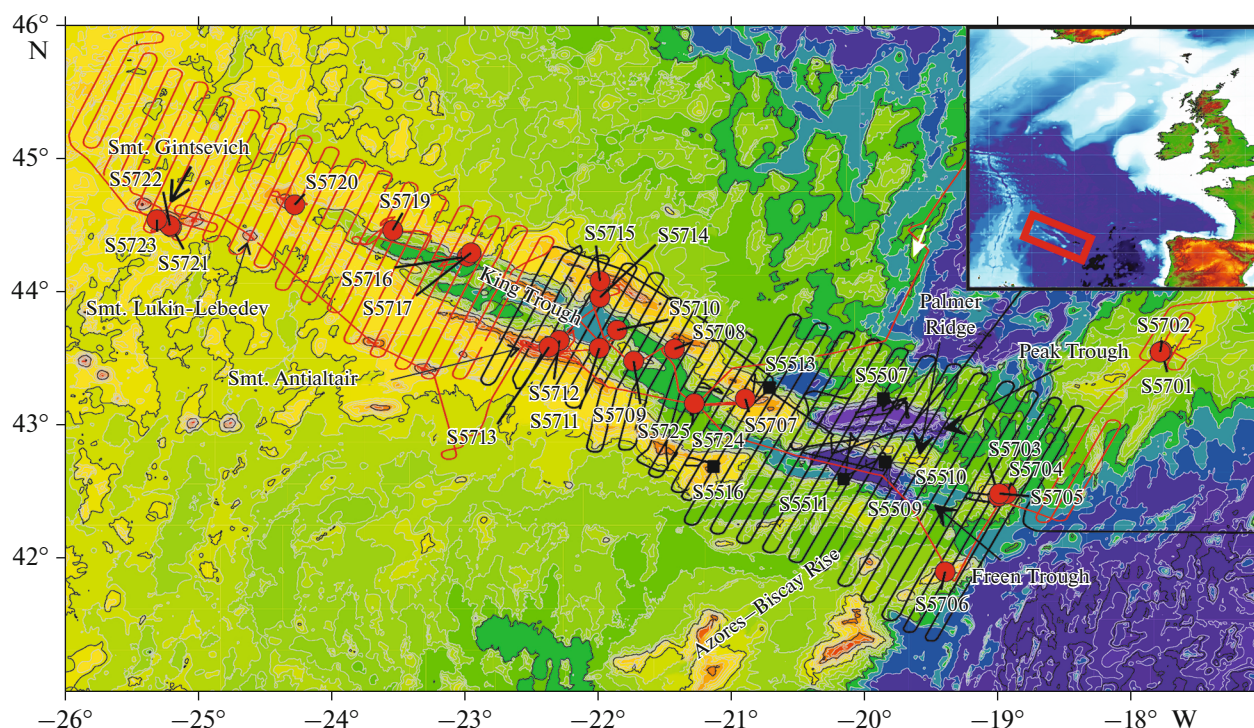


Fig. 1. Work scheme at King's Trough based on GEBCO-19 map (website <https://www.gebco.net>). Red circles, locations of dredging stations of cruise 57th of R/V *Akademik Nikolaj Strakhov*; black squares, of cruise 55. Station numbers are displayed next to them. Black and red lines, tracks of bathymetric survey and seismoacoustic and magnetic profiling, respectively, of cruises 55 and 57. Inset: location of King's Trough survey area.

(3) From the seismoacoustic profiling results, it was established that the sedimentary cover of the study area was formed on an oceanic basement subjected to neotectonic movements and deformations. The heterogeneous and mobile basement is the substrate on which a low consolidated sedimentary cover has accumulated, formed by background sedimentation of pelagic material and material transported by bottom currents. Evidence of drift deposits has been established. The rapid accumulation of material on slopes creates conditions for landslides and the formation of debris flow deposits. Four main types of seismic facies have been identified: (a) pelagic complexes; (b) contourites; (c) turbid flow deposits; (d) chaotic facies of gravitational genesis.

(4) In the area of the Gnitsevich Seamounts, signs of sound-scattering objects in the water column with vertical amplitudes above peaks of at least 200 m were discovered. This may indicate modern hydrothermal activity in this structure.

(5) Based on the hydromagnetic survey results, the position of magnetic anomalies discovered within the survey area was refined. The inferred boundaries and strikes of chrons C26n and C27n were identified, and the possible age of the crust bearing them was estimated in accordance with the geochronological scale at 57.7 and 61 Ma, respectively. Potential for identification linear anomalies were also noted, the interpre-

tation of which requires additional geomagnetic data to the south and north of the research area. The inferred extension of chron C25n through the Peak and Freen troughs was traced.

(6) It has been established that in anomalies older than C6p, the magnetic layer that generates them has been broken up under the King's Trough. At the same time, along the King's Trough, rupture and displacement of some numbered linear anomalies has occurred. The displacement along chron C25n exceeds 50 km; to the west, in the area of chron C24n.2n, the displacement decreases to 25 km, and in the area of chron C21n, it is not observed. Younger anomalies, including C6p, crossing the zone that continues the King's Trough are not degraded, displaced and change their strike.

(7) During the cruises, the following structures were investigated: the Peak and Freen troughs, volcanic structures of the Azores–Biscay Rise, the walls of the King's Trough, the plateau and volcanic structures formed on the flanks of the King's Trough, median ridges, and volcanoes of the Gnitsevich plateau. On the northern wall of the Peak Trough and on the walls of the King's Trough, a spreading rock association outcrops: basalts, dolerites, gabbros, and tectonites of these rocks. The second, most widespread rock association comprises altered basalts that form volcanic plateaus. In addition, the degradation products of volcanic rocks were obtained: breccias, grusstones, sand-

stones, and argillites. A large quantity of limestones was recovered from the surfaces of plateaus and large volcanoes, representing a noncoeval sedimentary cover on the slopes, differing in degree of lithification. Among them are uncommon varieties with an admixture of altered ash and tuff material.

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ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This work does not contain any studies involving human and animal subjects.

CONFLICT OF INTEREST

The authors of this work declare that they have no conflicts of interest.

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