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GEOPHYSICS

# Evolution of the Southern Part of the Canada Basin (Arctic Ocean) Based on Magnetometric Data

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Using a new Russian–American digital grid of anomalous magnetic field of the Arctic Ocean [1], oceanic magnetic anomalies were identified for the whole southern part of the Canada Basin (hereafter, southern CB), extending from the eastern scarp of the Northwind Ridge to the adjacent Banks Island–Mackenzie Delta continental margin. The geohistorical analysis of magnetic anomalies carried out based on the original procedure [2] revealed regional features of the basin evolution. Contradictory ideas about this evolution were so far based on the geology of continental framing.

The presence of spreading-related, fan-shaped magnetic anomalies in the southern CB has been known since the 1970s [3]. However, the strike of anomalies adjoining them has not been established, and the satellite gravitation minimum showed that the extinct spreading center (SC) occurs 75 km eastward of the site assumed by American geophysicists [4].

The available digital grid of the anomalous magnetic field and the possibility of plotting computed diagrams of magnetic anomalies along profiles of any orientation made it possible to distinguish and correlate two groups of anomalies: (a) fan-shaped anomalies with a submeridional symmetry axis coinciding with the gravity minimum, and (b) adjoining NE-trending anomalies in the west and east. Correlation of diagrams of effective magnetization $J_{ef}$ with a simulated magnetic field [5] showed that the fan-shaped group includes anomalies ranging from M16n to M5n (age ranging from 140 to 127.5 Ma, respectively), whereas the adjoining group includes anomalies ranging from M21 to M17 (148 to 141.7 Ma, respectively).

Axes of identified magnetic anomalies were plotted on the map of $J_{ef}$ diagrams (Fig. 1). The map shows two stages in the evolution of the southern CB. At the first stage (slightly earlier than 148 to 141.7 Ma ago), the axis of the SC extended northeastward. The spreading rate of the ocean floor decreased from fast to medium in the northeast direction (Fig. 1).

The activity of the first SC terminated 141.7 Ma ago. The newly formed submeridional SC (Fig. 1, anomaly M5n) split the first SC into two (southeastern and eastern) parts, corresponding to two parts of anomaly M17r in Fig. 1. During the second stage of the evolution of the southern CB, the initial slow opening of the floor gave way to an ultraslow and fan-shaped opening 132 Ma ago and termination of this process 127 Ma ago. The kinematic analysis showed the existence of three Euler poles, relative to which the ocean floor opening took place at the second stage of evolution. The poles calculated from three pairs of fan-shaped anomalies, are confined to the northeastern part of the Brooks Range that represents a Mesozoic compression area (Fig. 1). The beginning of the fan-shaped opening corresponds to the paleomagnetic data on Lower Cretaceous rocks in boreholes, according to which Alaska began to rotate relative to North America not before the late Valanginian (141–136 Ma ago) [7].

To establish peculiar features in the formation of the southern CB at the first evolution stage, we carried out plate tectonic reconstructions of the oceanic floor for the period from the onset of spreading slightly earlier than 148 Ma ago to the completion of the first stage 141.7 Ma ago (Fig. 2). The reconstructions showed that, prior to spreading in the southern CB, a continental crustal block was sandwiched between the oceanic crust of the northern part of the Canada Basin (hereafter, northern CB, located north of the transform fault in Fig. 2) and Alaska (Fig. 2c). The spreading began with the breakup of the Banks Island–Mackenzie Delta con-

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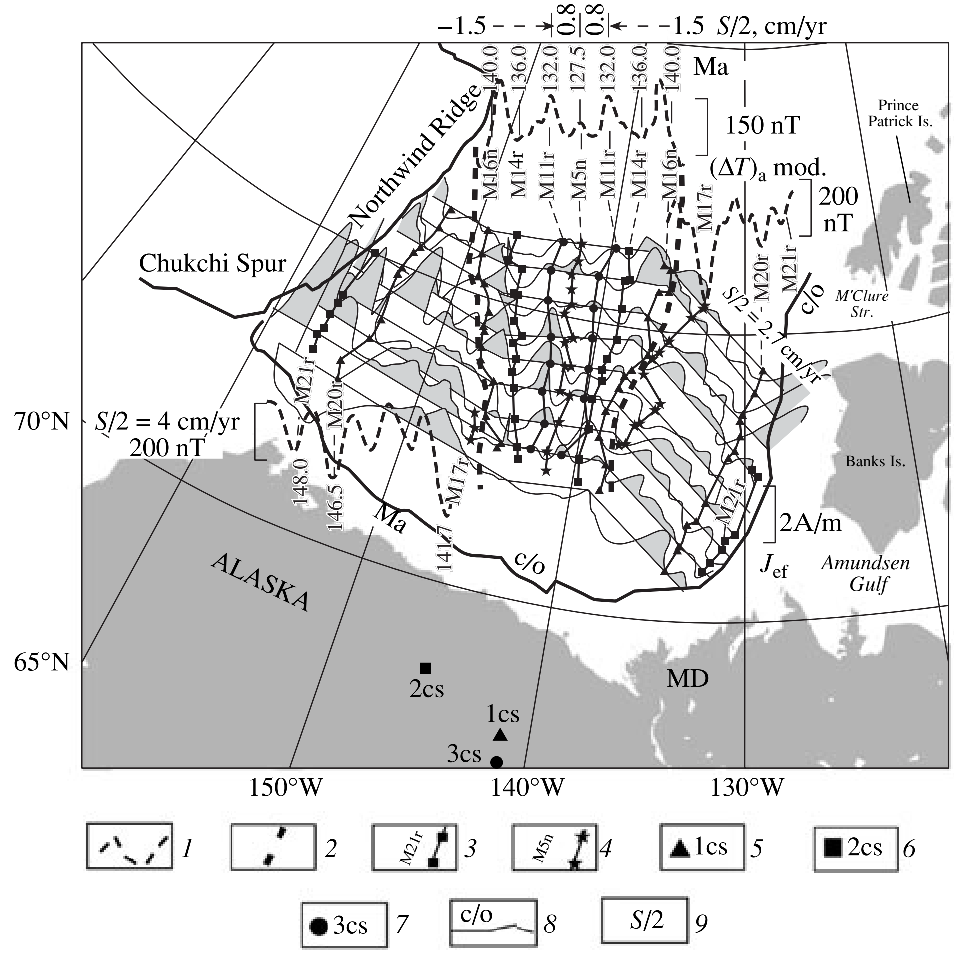


**Fig. 1.** Effective magnetization in the southern CB with axes of identified magnetic anomalies and the continent/ocean transition zone. (*1*) Graphs $(\Delta T)_a$ from the inversion model of a magnetoactive layer; (*2*) boundaries of floor areas formed at different evolution stages; (*3*) axes of magnetic anomalies and their designations according to the magnetostratigraphy time scale in [6]; symbols on axes of magnetic anomalies (except for axial anomalies confined to SC) are arbitrary; pair axes of anomalies have similar symbols; (*4*) axial anomalies: (M17r) confined to SC of the first evolution stage, (M5n) confined to SC of the second evolution stage; (*5–7*) Euler poles of the fan-shaped floor opening at the second evolution stage: (*5*) 140 Ma ago, (*6*) 136 Ma ago, and (*7*) 132 Ma ago (pole symbols correspond to symbols on axes of fan-shaped anomalies used to determine the pole); (*8*) continent/ocean transition zone; (*9*) spreading half-rates. (MD) Mackenzie River delta.

tinental margin, located southwest of Banks Island, and the rotation of the block relative to a pole located west of the central part of the island. Figure 2 demonstrates a small oceanic crustal area that emerged at the onset of the spreading and adjoined the line, along which the continental crust breakup continued at the first evolution stage to form the Banks Island–Mackenzie Delta continental margin by the end of the first stage. The pole of opening appreciably shifted northeastward 146.5 Ma ago to the boundary between the Sverdrup Basin (spreading area) and the Franklin mobile belt (compression area), whereas the SC shifted to the northeast and southwest (Fig. 2b). At that time, the western continental margin included the southern part of the Northwind Ridge, which extended and accreted in the northeastern direction, and the sublatitudinal Chukchi Spur moved westward along the transform Alaska margin. The continental crustal area still separated the oceanic crust of the southern and northern parts of the Canada Basin. The oceanic crust of the southern CB joined the oceanic crust of the northern CB (Fig. 2a). Discrepancy between spreading directions in both parts of the basin (the ocean floor spreading proceeded along the transform fault shown in Fig. 2 in the northern CB [2, 8] and at an angle to the fault in the southern CB) terminated the spreading in the Alpha Ridge area and the northern CB. Jumping of the SC and initiation of the fan-shaped opening of the floor in the southern CB provoked the counterclockwise rotation of Alaska and the Chukchi Borderland by 22°.

Thus, the southern CB formed from the Tithonian to Hauterivian, owing to the ocean floor spreading from two consecutively acting SCs at two evolution stages. Prior to spreading, the Chukchi Borderland was located

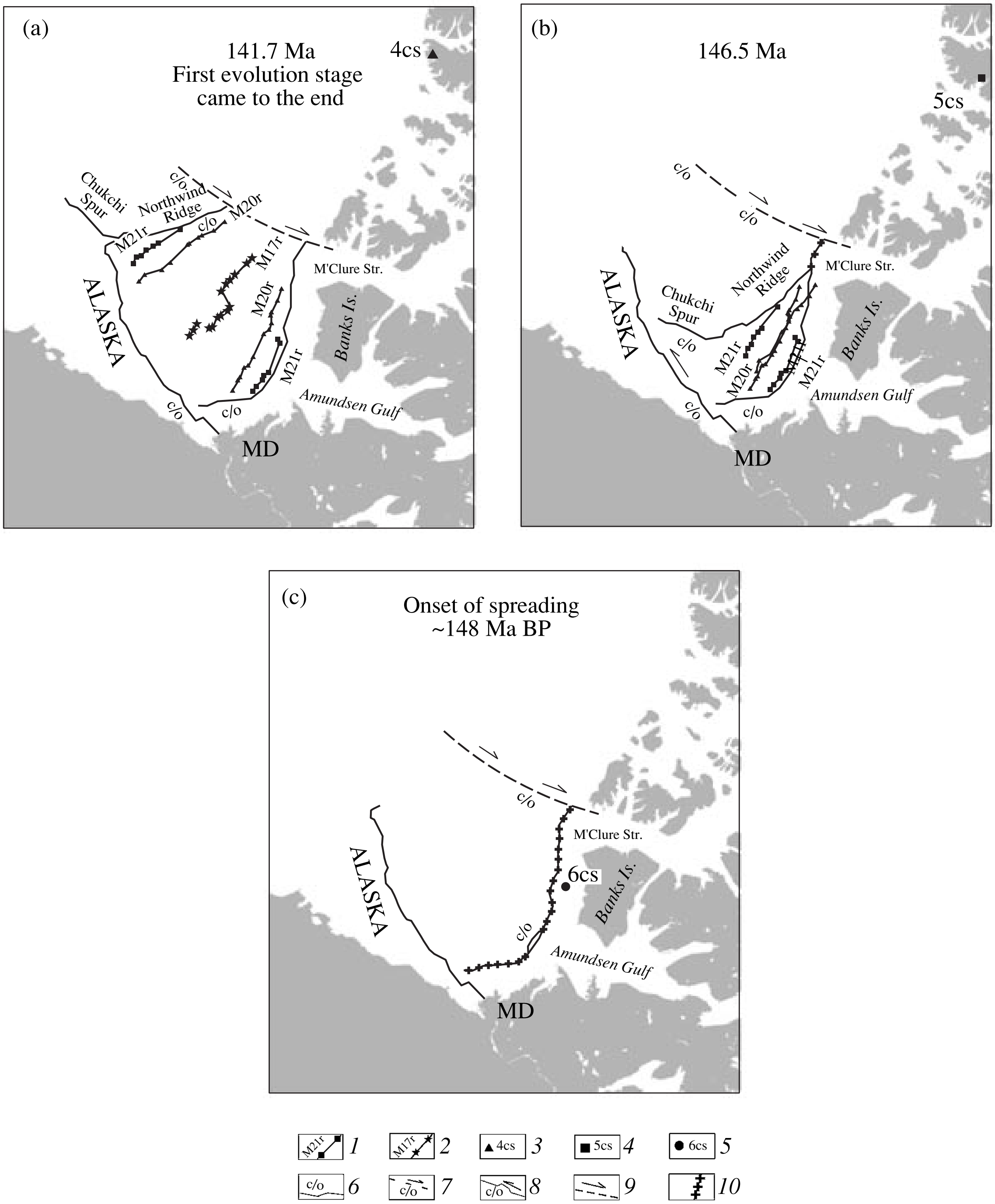


**Fig. 2.** Reconstructions of seafloor in the southern CB formed at the first evolution stage from the onset of spreading to 141.7 Ma ago: (a) 141.7 Ma ago, (b) 146.5 Ma, (c) slightly earlier than 148 Ma ago. (*1*) Axes of magnetic anomalies and their designations according to the magnetostratigraphy time scale in [6] (pair axes of anomalies have similar symbols); (*2*) axial anomaly confined to SC of the first evolution stage; (*3–5*) Euler poles of fan-shaped floor opening at the first evolution stage: (*3*) 146.5 Ma ago, (*4*) 148 Ma ago, (*5*) slightly earlier than 148 Ma ago (pole 6cs was calculated based on continent/ocean (c/o) conjugate transition zones, and the floor spreading in the southern CB began relative to this pole); (*6*) boundary of the passive continental margin; (*7, 8*) boundary of the transform continental margin of the northern CB and southern CB, respectively (arrows show the direction of motion); (*9*) part of the transform fault (east of SC) that bounded in the south the ocean floor spreading in the southern CB and presumably extended to the M'Clure Strait [2, 8] (arrows show the direction of motion); (*10*) part of the line designating the position of the future Banks Island–Mackenzie Delta continental margin, along which the continental crust has not yet broken up at the time interval of reconstruction.

near the Banks Island–Mackenzie Delta continental margin, and moved along the Alaska transform margin during the first evolution stage and rotated counterclockwise along with Alaska during the second stage.

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