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Invited Review

Arctic lithosphere — A review

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ABSTRACT

This article reviews the characteristics of Arctic lithosphere and the principal tectonic events which have shaped it. The current state-of-knowledge associated with the crust, crustal-scale discontinuities, and their ages, as well as knowledge of the lithosphere as a whole from geophysical data, permits the division of Arctic lithosphere into discrete domains. Arctic continental lithosphere is diverse in age, composition, and structure. It has been affected by at least two periods of thermal overprinting associated with large volumes of magmatism, once in the Permo-Triassic and again in the Aptian. In addition, it was attenuated as the result of at least five phases of rifting (in the late Devonian–early Carboniferous, Permo-Triassic, Jurassic, Early Cretaceous, and Late Cretaceous–Cenozoic).
Older phases of consolidation are associated with continental lithosphere and occurred through a series of continent–continent collisions in the Paleozoic. Jurassic and Cretaceous extensional phases are related to the dismembering of Pangea and Eurasia, and were concentrated in the Norway-Greenland and Canadian-Alaskan Arctic regions. Large areas of submarine, hyperextended continental (?) lithosphere developed in parts of the Amerasia Basin. After continental breakup and the accretion of new oceanic lithosphere, the Eurasia and Canada basins were formed.

Contents

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1. Introduction

The tectonic evolution of the Arctic is among the most debated of any region on Earth (e.g. Pease et al., 2011). The geology is complex and working in the Arctic is logistically difficult. Nevertheless, several factors are accelerating the growth of what is known of the region, including technological advances in geophysical data acquisition, the quest for natural resources beneath an ocean experiencing a progressive reduction in ice cover, and the United Nation's Law of the Sea Treaty. A number of large, often international, campaigns have conducted marine, airborne and land-based geophysical and geological investigations in the Arctic region in the last decade (e.g. Lawver et al., 2010) and more are planned.

The main element in reconstructing the tectonic evolution of any region is the lithosphere: continental and oceanic. It follows that understanding the affinity and history of the lithosphere of geological

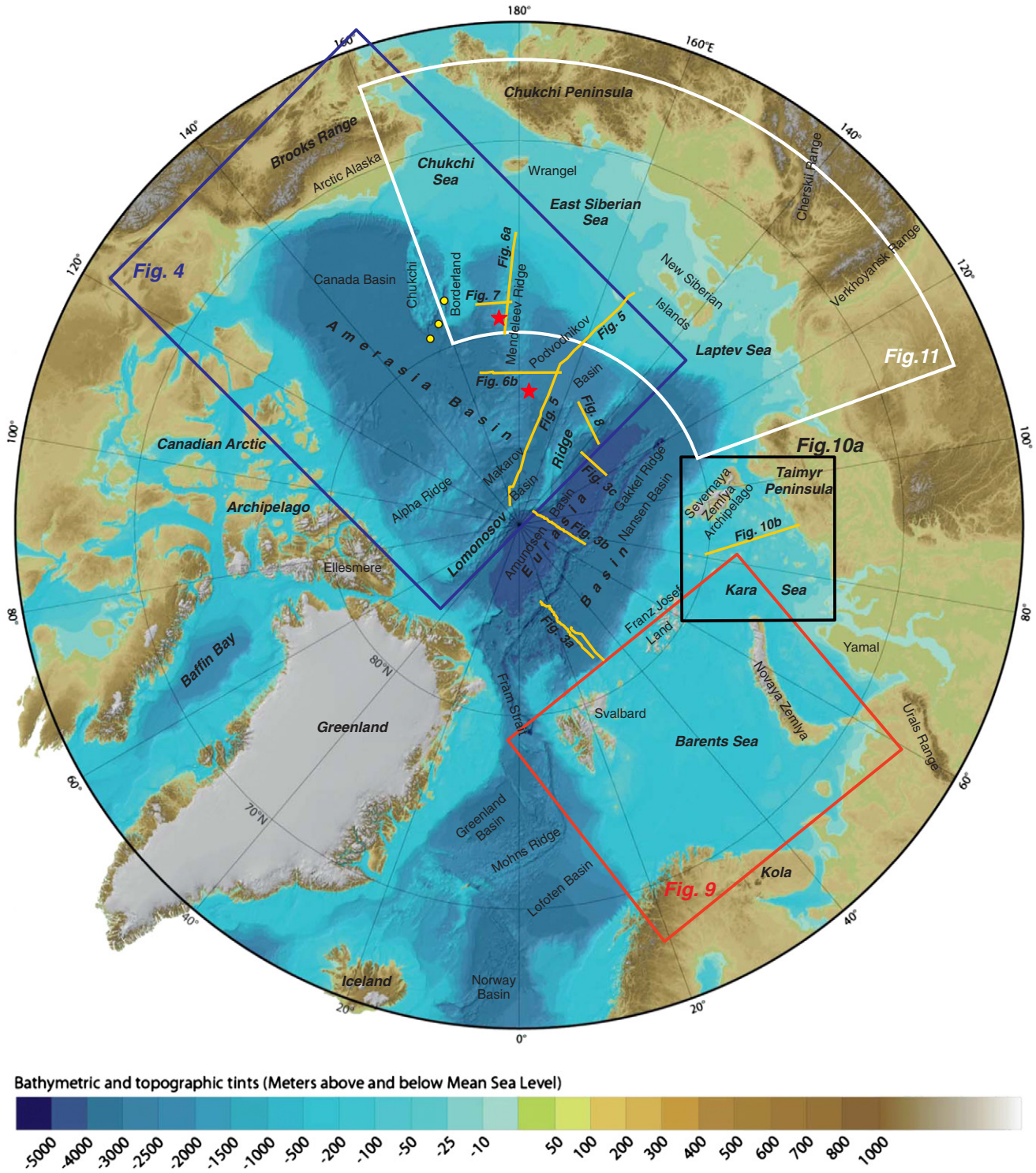

Fig. 1. Physiographic domains and seas of the Arctic region (after Jakobsson et al., 2012). Yellow lines show locations of seismic refraction and reflection lines used in subsequent figures (figure number given for reference). Subsequent figures indicated by rectangles. Red stars denote shallow Russian 2012 drill sites. Yellow circles show location of Healy 2009 dredging (refer to text for more details).