



Eurasian Arctic Margin Expeditions: Testing Hypotheses for the Opening of the Arctic Basin

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Understanding the tectonic evolution of the high Arctic Basin should be *the* major Arctic science challenge of IPY. The lithosphere hidden beneath the northern polar ice is the least known and most enigmatic crust and mantle on Earth. Establishing the origin of this ocean is important not only for understanding on-going change in the Arctic; it also controls how we think about all the older history, not least the various Mesozoic, Palaeozoic and Precambrian orogens that strike north towards the pole and disappear beneath the ice into the Arctic enigma. And, of course, it controls how we view the resource potential of the wide continental shelves around most of the deep ocean.

The origin of the Eurasian Basin is not controversial. Slow Tertiary sea-floor spreading has left unambiguous magnetic signatures; the central Gakkel Ridge has been the target of several expeditions and the oceanic crust has been mapped and sampled. This implies that the structure of the Lomonosov Ridge should correspond closely to that of the outer Eurasian margin. Sediment provenance studies can test this hypothesis.

The big controversies centre on the vast region of anomalous crust of the Amerasian Basin lying to the north of Canada Basin, dominated by the Alpha-Mendeleev ridge system. This may indeed be an essentially volcanic province generated in the late Mesozoic by separation (60-70° rotation) of the Alaskan – Chukcha – East Siberian margin from the Canadian Shelf; however, this is but one hypothesis, and has many opponents. Testing alternative hypotheses requires a knowledge both of the structure and composition of the central Arctic lithosphere and the geology of the continental shelves flanking the ocean.

For the last fifteen years, SWEDARCTIC international expeditions, involving collaboration between geoscientists from several western European countries and Russian colleagues, have worked the Eurasian Arctic margin at 78 – 80° N from Svalbard to Severnaya Zemlya. The continuation of the Caledonide Orogen from Scandinavia through the Barents Shelf and connections to the Laurentian margin in the Greenland Caledonides has been established. Relationships between the Barentsian Caledonides and Baltica's Neoproterozoic Timanide margin have been defined. Novaya Zemlya is now the prime target. Separating the vast hydrocarbon provinces of the eastern Barents Shelf and western Kara Shelf, this thousand kilometres long, one hundred kilometres wide, archipelago is a largely Palaeozoic fold and thrust belt; it contains key evidence for understanding Hercynian – Cimmerian orogeny in the Arctic and the structure of the Eurasian Shelf.

The classical ocean-derived allochthons (ophiolites and arc-volcanics) and high pressure eclogite-blueschist footwall complexes of the Uralides, characterizing the entire length of the orogen, reach the Polar Urals near the Kara Sea and then are seen no more. Do they occur in the deeply buried Palaeozoic complexes beneath the western Kara Sea adjacent to Novaya Zemlya? They do not outcrop in Taimyr where they may be cut out by transcurrent faulting. And what can the Neoproterozoic to Early Triassic successions of Novaya Zemlya tell us about the development of the adjacent Barents and Kara Sea basins?

Work on Novaya Zemlya started in 2004, will continue in 2005 and, perhaps, the coming years, culminating in IPY. The first major international geological expedition since the Second World War visited southernmost Novaya Zemlya (71° N) in July-August 2004. This Swedish, Russian, British and Norwegian collaboration took the first step in a new analysis of archipelago. In this region, Late Neoproterozoic "basement" is deformed during Timanian Orogeny, truncated by an Early Ordovician unconformity and overlain by a Palaeozoic succession that is dominated by platform carbonates, reaching up into Permian flysch. In 2005, the target is harder – the far north at 77° N, to examine strata of similar age, but apparently without the unconformity and in basal facies. Work in 2006 – 8 will depend on the "flexibility" of the Russian Naval authorities.

Other targets are also planned for 2006 – 8 to better define the bedrock geology of the western segment of the Eurasian margin, both on October Revolution Island and Bol'shevik Island (Severnaya Zemlya), and Nordaustlandet (Svalbard). Integrated with new studies of the Canadian, Alaskan and Chukchi margins, there should be a platform for thorough testing of trans-Arctic correlations by the time of IPY and the International Geological Congress 2008.