OPINION
on report by M. K. Bakhteev, O. A. Morozov, S. R. Tikhomirova, and V. S. Sverdlov,
"Structural and Material Associations, Tectonics, and History of Development
of Eastern Kamchatka"
*(extracts regarding factual material obtained from large-scale (1:50,000)
geological mapping of key areas of Eastern Kamchatka in 1989–1991;
remarks on interpretation of factual material are omitted)*

This report summarizes four years of activity by a group of authors that was fairly strictly regulated by the sponsor. Therefore they had to combine under a single cover three fairly independent reports on the geology of three areas, remote from each other, unrelated even by common stratigraphy, and each presenting unique, fairly complex problems to researchers. The report makes a very important contribution to their solution, but the authors were unable to overcome fully the original fragmentary nature of the material. Therefore I must evaluate each of the four main sections separately.

A. The ***Kamchatka Mys peninsula*** is one of the region's best known tectonic centers, which far outranks others in terms of number of special projects and dissertations defended on this basis…

…The foundations of modern understanding of the peninsula's geology were developed in the works of M. Yu. Khotin, which remain quite relevant today. At that time it was suggested that Cretaceous stratified associations and ultrabasic-basic plutonic rocks form a complicatedly dislocated ophiolite association that can be correlated with formations of modern oceanic structures.

All subsequent researchers have **just developed this idea**, adding details, classifying deep rock associations, and proposing various interpretations of the overall structure of the peninsula. However, the evidentiary side of all the innovative ideas has remained very weak, since after Dolmatov's survey no researcher has published any detailed maps for this territory.

The **reviewed report gives the first such map, which lets one validly choose a given solution or hypothesis**. It deserves the highest appraisal. The map is very detailed, and its drafting is effectively provided with observations, as illustrated by the **map of factual material**. Undoubtedly compilation of this map required exceptionally great efforts, considering the very poor accessibility and even worse interpretability of this region.

In the process of this mapping an enormous amount of diverse factual material was obtained, providing a more reliable basis for solving problems of the area's stratigraphy, magmatism, and structure.

The Cretaceous stratigraphy developed by M. Yu. Khotin was fully **confirmed**, and dates of the major subdivisions were **revised**.

Theories about the composition of magmatic and sedimentary rocks were substantially **supplemented**. The Miocene–Pliocene dike series was described in detail for the **first time**. Certain corrections were **introduced** to the stratigraphy of the Neogene and

Pleistocene sedimentary sequences. A system of thin, gently sloping sheets that form the basis for the area's structure, at least its western portion, was **outlined**…

5. Identification of the Miocene-Pliocene association of small intrusives, as I already mentioned, is an **important achievement** of the authors. ...There is no detailed correlation of rocks from obvious intrusives and from inclusions in melange, which is important for further tectonic mapping…

8. An **important achievement** of the authors is the establishment of the upper age limit for the formation of **serpentinite melange due to finds of blocks** of Miocene rocks and Miocene–Pliocene dikes in it…

11. **Identification of a system of very active northwestern right-lateral strike-slips with movement rates perhaps limiting for subaerial structures** of this type absolutely requires a more expanded system of argumentation than the one presented in the report. This is especially important, because these faults very rapidly diminish or are cut off by other (younger?) ones both in the northwest and also in the southeast, where a completely different system of modern fractures within the ocean area is shown. Incidentally, the procedure for identifying such fractures underwater also deserves special description (or citation of the source).

B. The ***Kronotskii isthmus*** is a much less popular place than the Kamchatka Mys peninsula, probably because of its **difficult access** and the absence of ophiolites, which have so attracted geologists recently.

This area is by no means the easiest subject in terms of accessibility, interpretability, lithological homogeneity of the sequences developed here, and very complex tectonics. It is also the first area studied by the authors in Kamchatka.

The result was a beautiful **map based on a completely new approach** to the structure and stratigraphy of the sequences developed here.

Eocene formations of different facies were identified for the **first time** in this region and in this structural facies zone of the Tyushevka trench.

Along with sheet-like overthrusts, gentle nappes were depicted for the **first time**, and thick tectonic sedimentary melange was depicted as independent geological bodies…

C. The ***Valaginskii ridge***. The authors achieved very important results here: for the **first time** in detail and in a relatively large area they classified terrigenous deposits previously placed into the Vakhvinskii, Vaskuchevskii, or Tal'nikovskii suites and demonstrated that this entire terrigenous sequence is bedded above Upper Cretaceous volcanogenic deposits. **Careful study of the structure** of the Vetlovskii suite **provided persuasive proof** of the validity of **identifying** this stratigraphic subdivision, which had sometimes been viewed recently as **unique tectonic melange**.

New biostratigraphic data were obtained at the same time, confirming the Cenozoic age of most of the suite profile. Identified for the first time at the boundary of these two associations was a **broad band of tectonic sedimentary melange**, and its internal structure was established for the first time.

A Middle Eocene sequence that overlies with unconformity all older associations and structures, including the melange zone, was **discovered for the first time** in this part

of the Valaginskii ridge. **This allows reliable dating of the main tectonic events** responsible for the structure of the area.

The age of Neogene sequences and the composition of small Miocene-Pliocene intrusives, among which alkaline varieties **were identified**, have been revised. All this is reflected on the **geological map, the quality of which cannot be praised sufficiently**.

…The authors were given very severe conditions, since it is difficult, if not entirely impossible, to analyze paleogeodynamics only through material of three very small areas. One could have drawn upon the vast material in the literature for analyzing and interpreting it in light of the obtained results. However, this is obviously an enormous and independent project that far exceeds the scope of the sponsor's funding.

We will now summarize. In geological research one should evaluate three aspects: first, the quantity and quality of the factual material obtained, second, presentation of this material in a user-friendly way, and third, interpretation of the material for given purposes.

It is obvious that the presented report contains a formidable supply of completely new and, importantly, reliable **factual material obtained by systematic geological mapping of very complex key areas**. I am sure that the potential for study of this material, including collections assembled by the authors, **is far from exhausted**.

I also assess the presentation quality of this material very highly. I must emphasize again first of all the **very high level of the geological maps, the main document reflecting the colossal amount of work done by a comparatively small group of authors**. But other graphic materials and the text of the report are masterful, and they illuminate the composition, age, and structure of the studied subjects very completely. There are only isolated criticisms of the way the material is presented.

Most criticisms relate to interpretation of the factual material. This does not mean that the authors made some fundamental errors. I have simply tried to show that in some cases the material is too complex or too incomplete for the authors' interpretation to be seen as unambiguous and conclusive. I hope that I have managed to do this, as I have managed to reflect the high quality of the report as a whole, which deserves an outstanding evaluation.

It is especially nice that the research was conducted with participation of a **large number of students, who during this time undoubtedly attended a superb school of geological mapping and saw a living example of a creative approach to the work**. This result is probably at least as important as all other work cited by the authors in the Conclusions section.

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