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## THE BAIKAL RIFT

### *LE RIFT DU BAÏKAL*

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This series of papers on the Baikal Rift (Fig. 1), prepared with the agreement of Elf Aquitaine Edition to be published in subsequent issues of the Bulletin des Centres de Recherches Exploration-Production Elf Aquitaine, consists of more than ten articles written mainly by scientists from the Institute of the Earth's Crust, Siberian Division of the Russian Academy of Sciences. Since the late 1960's these scientists, unlike anyone else from other research institutions of the former USSR or Russia, have been engaged in systematic investigations of the geology, neotectonics, seismicity, geodynamics and deep structure of the Baikal Rift, mainly in connection with the realization of the national parts of international geological and geophysical projects and programmes. Over the last three decades, the rich variety of methods used has provided a wealth of information now published in numerous monographs and journal papers, mostly in Russian. Despite all these publications, however, many results obtained by Siberian scientists in the Baikal Rift remain unknown to most foreign specialists in interplate phenomena from Western countries, no doubt partly due to the language barrier. Figuratively speaking, this unique zone of continental rifting in Central Asia, which has a very impressive structure and morphology, has stayed as if "half-isolated" from the process of active studies of the problems of continental rifting.

The first important lifting of the "information shade" over the work of Russian scientists in western literature occurred in 1978 when the special issue "Geodynamics of the Baikal Rift Zone" of the journal *Tectonophysics* (vol. 45, 1, 1978) was published. Its 11 articles, presented by Siberian geologists and geophysicists, are devoted to the results of investigations carried out in the Baikal Rift zone within the framework of the International Geodynamic Project (during the 1970's). Another "informative breakthrough", though of less importance, took place in connection with the publication of a special issue of the same journal under the title "Geodynamics of Rifting" edited by P. Ziegler. This includes four papers by Siberian scientists presenting some results of the Baikal Rift research as a part of the International Lithosphere Programme (*Tectonophysics*, vol. 208, 1-3, 1992).

During the fifteen years which have passed since the publication of the special issue "Geodynamics of the Baikal Rift Zone", our knowledge and understanding of this area has increased considerably. Recent investigations have provided new data which allow a significant review of the various topics of development of the Baikal Rift. Thus, the main purpose of this special series is to acquaint western readers with our current knowledge on the Baikal Rift, as many of the concepts previously put forth have changed considerably within the past years.

The Baikal Rift belongs to a family of Cenozoic continental rifts including the rift zones of East Africa, Central Europe, North America and Asia. Its geodynamics and structural evolution have a lot in common with those of other continental rifts. All of the rifts are related to a mechanism of lithosphere extension which may be driven both by a local and an external energy source. At the same time, each member of the family possesses its own peculiarities, and so does the Baikal Rift as demonstrated in the papers that follow.

The Baikal Rift is distinguished from others by its initiation and development in the inner part of a large continent at a great distance from the major fronts of collision of the Pacific plate, the Hindustan subcontinent and Eurasia. The distance between the Baikal Rift and the zones of collision is about 2000-2500 km. No evident structural connections between the extension of the lithosphere that causes rifting in Inner Asia, namely the Baikal Rift, and the main zones of collision have been revealed. The Baikal Rift is probably a unique intraplate phenomenon with its geodynamics and tectonics mainly driven by a local energy source. Opening of the Baikal Rift began primarily due to an extension at the junction of the two major lithospheric plates in East Siberia which have contrasting properties – the Precambrian Siberian craton and the adjacent Sayan-Baikal mobile fold belt. It is the very place where the lithosphere extension started that is now occupied by the largest depression of the rift system, Lake Baikal, the deepest fresh-water lake in the world.

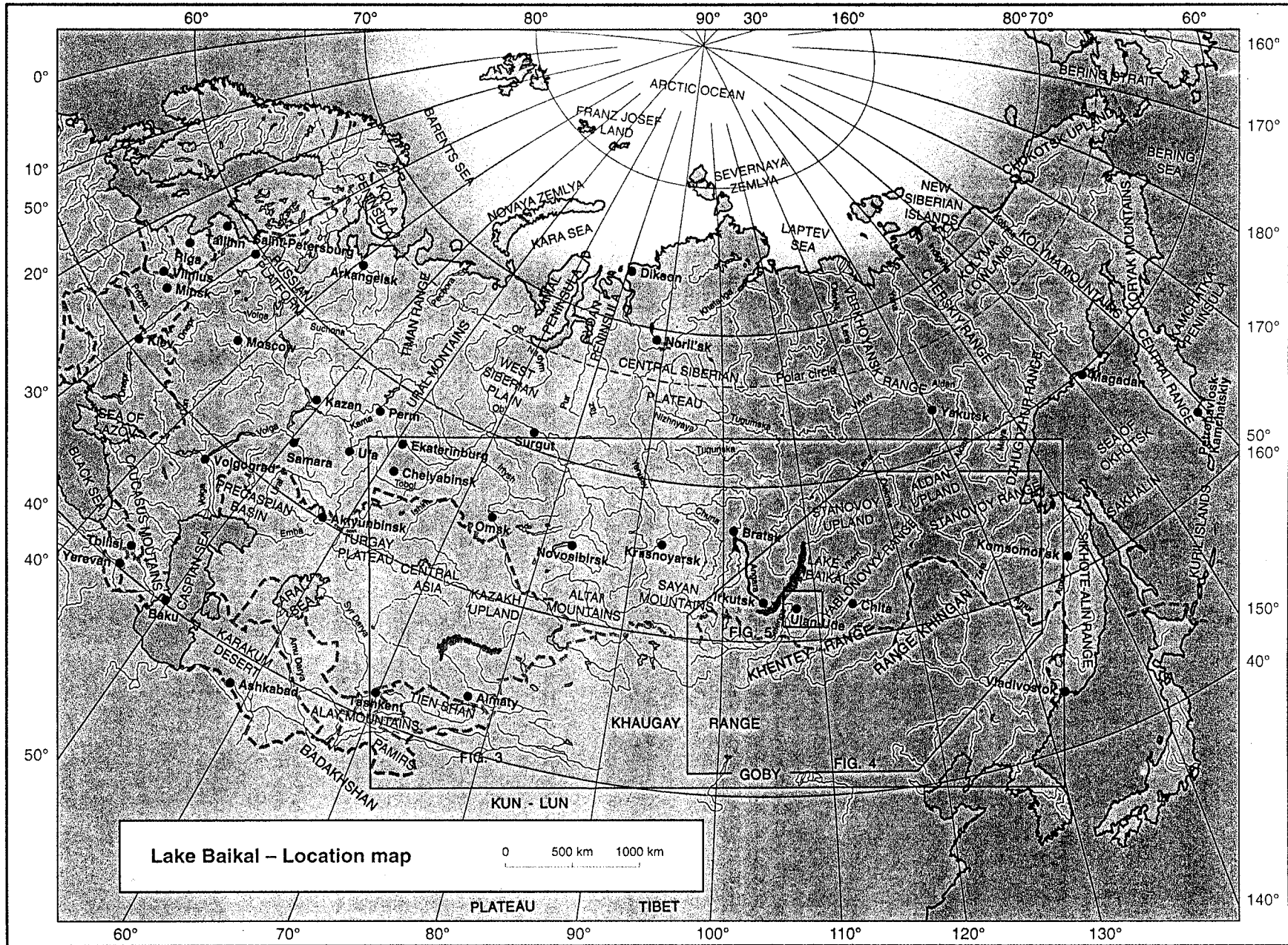


FIGURE 1 — The location of Lake Baikal.

The series of papers presented here starts with a review of the history and geodynamics of the Baikal Rift. This paper can be viewed as a general introduction to the specific problems of continental rifting in East Siberia. The accompanying papers in this special issue focus on the following topics :

- the composition and structural evolution of the basement created by the combined effects of tectonic movements, magmatism and metamorphism at the pre-rift stage of development of the Baikal region;
- the Mesozoic evolution of East Siberia, renowned for its system of rift valleys and uplifts developed in the Late Jurassic – Early Cretaceous, which is, in many respects, similar to the Cenozoic basins and the Range province of the western United States;
- the composition and evolution of the sedimentary infill of the Baikal Rift valleys through the background of changes in the rate and character of tectonic movements, topography and climate;
- the evolution of volcanism, its petrochemistry and possible relationship with deep-seated processes.

The next issues of the Bulletin will present papers devoted to the following features of the Baikal Rift :

- active faults at the bottom of Lake Baikal which form a considerably dense and complicated mosaic pattern dissecting the bottom sediments and are occasionally independent of the faults in the basement;
- seismicity of the Baikal Rift, which is thought to be highest among those typical of other continental rifts and may be evidence of either low heating of the lithosphere or of lithospheric extension taking place faster there than in other rift zones of the world, or both phenomena together;
- structural and kinematic reconstructions of the stress field during rifting in the Baikal region;
- heat flow in the Baikal region, especially in the Baikal basin, and the relationship between the geothermal field and the geological structure of the Baikal Rift.

The articles dealing with these issues describe the major characteristic features of the Baikal Rift with the exception of its deep structure, though this too has been investigated by a variety of geophysical methods as used in other continental rifts. However, this topic may be discussed in subsequent issues of the Bulletin or elsewhere. Nevertheless, we hope that the set of papers presented here gives a comprehensive review of the main results of the Baikal Rift studies for the past few years.

Being a unique morphological and structural feature of Inner Asia, the Baikal Rift has been extensively studied by Russian geologists and geophysicists in connection with international research projects and programmes. The results of these studies are a national contribution from scientists from the former USSR and Russia to international cooperative research. Since the late 1980's, mainly due to perestroika in the USSR and the greater openness of our society, scientists from foreign countries have increased their participation in geological and geophysical investigations in the Baikal Rift. Most of the research is now being conducted for the comparative analysis of continental rift systems including the Baikal Rift – the western branch of the East African Rift System, the Baikal Rift – the Rio Grande Rift, the USA and the Baikal Rift – the Fen Wei (Shanxi) Rift, China. The basic condition of such comparative research is the cooperation of efforts and joint field studies of scientists from Russia, Belgium, the USA and China in the regions of continental rifting under comparison.

In 1991-1992, in addition to comparative studies, Russian geophysicists from the Institute of the Earth's Crust, Irkutsk and American geophysicists from the University of California, Los Angeles and the University of Wisconsin, Madison, carried out a teleseismic tomography of the mantle of the Baikal Rift. A network of teleseismic stations was installed across the strike of the lake and in an array around the lake and in the neighbouring Mongolian territory. The data obtained are currently being processed and interpreted.

The multichannel seismic profiling which was carried out by specialists from the Institute of Oceanology, Russian Academy of Sciences, Moscow, in 1989, considerably contributed to deciphering the structure of the sedimentary infill of Lake Baikal. The data obtained from approximately 15 profiles across the lake basin were processed and analysed in collaboration with specialists from the Marine Geology Department, USGS, Woods Hole. These data provided the first actual estimates of the thickness of the sedimentary infill and gave an insight into its internal structure and the role of faulting at different stages of the basin's formation.

Within the framework of international cooperative studies of the Baikal Rift and its comparison with other continental rifts, the idea to establish the International Centre for Active Tectonics and Natural Disasters (ICAT) came about. This Centre was initiated by the Siberian Division of the Russian Academy of Sciences and the Royal Museum of Central Africa, Belgium, in December 1992. The official headquarters of the Centre is at the Institute of the Earth's Crust in Irkutsk which is situated in the vicinity of the tectonically and seismically active Baikal Rift. The Institute is located 60 km from Lake Baikal and has aided specialists in active tectonics and the assessment and prediction of natural hazards in various geodynamic regimes of the lithosphere. There is also an infrastructure of the facilities and services required for scientific investigations in the Baikal Rift and other geodynamic regimes. The ICAT is available for institutions and scientists from other countries to participate in its activities.

The special series of articles on the Baikal Rift to be published by Elf Aquitaine Edition has been prepared according to the agreement between the leaders of the ICAT (J. KLERX, K. LEVI, N. LOGATCHEV) and the editor of Elf Aquitaine Edition, Dr. R. CURNELLE, which was obtained during Dr. CURNELLE'S visit to the Institute of the Earth's Crust May 18-21, 1993. We express our great appreciation to Dr. CURNELLE for his effort aimed at a new "information road" to the West for the results of scientific research carried out in the Baikal Rift.

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