U.S.-Soviet Climate Research: More, Better

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The draft of an agreement for cooperative U.S.-Soviet climate research contains a number of proposed projects that should lead to unprecedented knowledge of the worldwide atmospheric distribution of trace gases and their effect on climate change. Activities named in the document include the shared measurement of Antarctica's ozone hole, a joint experiment to investigate the relationship between aerosols and ozone in the Arctic stratosphere, and a program to measure biogenic methane produced in permafrost areas of the United States and the Soviet Union.

The protocol, signed in preliminary form November 2, 1987, by representatives of both countries, is the latest update of a bilateral agreement in place since 1972. Ultimate approval of the protocol should come in the next few months, in the form of a final signing by Environmental Protection Agency (EPA) Administrator Lee Thomas and the head of the equivalent ministry in the Soviet Union, Yuri Izrael.

The rationale for the protocol since its implementation has been that the study of climate and the atmosphere is a global job. Knowledge of the large part of the planet that lies in or near the Soviet Union is needed for a complete picture of present-day world climate, a requirement for accurate forecasting of future climatic trends. Two of the proposed activities involve monitoring of chloroflourocarbon levels in Lake Baikal, north of Mongolia, and measuring aerosols and ozone on Heiss Island, within 10° of the North Pole.

Another important function of cooperation is confirming data. "We can reinforce each other's conclusions," says Robert Etkins, assistant director of the National Climate Office in Boulder, Colo. International standards for measurement of trace gases will be essential to the future of the multinational Montreal agreement on CFC production completed in September. Soviet and U.S. lidars used to measure stratospheric aerosols would be cali-

Forum

Development of Plate Tectonics Theory: The Missing Piece

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The recent article by Jean-Claude Mareschal ("Plate Tectonics: Scientific Revolution or Scientific Program?" in *Eos*, May 19, 1987, p. 529) adds to the interesting literature on the evolution of the theory of plate tectonics. It is curious that an aspect of the general theory that seems to be little considered and mentioned by Mareschal or others who write about the history of development of the theory, but that was vitally important in my own acceptance of the theory, was the discovery of subduction and, to a lesser extent, abduction.

Earth's surface is essentially conservative over periods of millions of years, and if continents were drifting, what was happening to the rigid oceanic crust? The concern only was exacerbated by seafloor spreading. I was well aware of Benioff seismic zones (as they were referred to in the United States during the 1950s) but had not connected them to foundering oceanic crust. In this regard, I found a paper by *Coats* [1962] to be very interesting but did not connect it, for some reason, with the overall picture. In this paper, Coats gave evidence of underthrusting of the oceanic crust under the Aleutians and used it to explain andesitic volcanism. A number of years later, I found it impressive that *Oliver and Isacks* [1967] also found seismic evidence of foundered oceanic crust.

It was not until early 1968, when I was talking to the late Paul Gast about a manuscript I was preparing on the isotopic signatures of lead and strontium in the tectonic environments from oceans ridges to continental cratons [*Doe*, 1968], that my concerns began to be resolved. Paul suggested that I come to the Lamont-Doherty Geological Obvservatory (Palisades, N.Y.) and get together with Lynn Sykes to discuss a manuscript he was involved in. I did this just prior to the AGU Annual Meeting in 1968 and learned about the "New Global Tectonics" [*Isacks et al.*, 1968], which is a little-cited paper that presented a unified model allowing for seafloor spreading, continental drift, and a conservative earth surface through what is now called subduction. All the critical pieces were then put into place. I have long found it surprising that a paper I found so important to my acceptance of plate tectonics, and one of the most exciting papers I have read in my career, is so little cited in the scientific literature and so little discussed in the historical literature.

It also seems to me that development of the theory of subduction deserves "equal time" with seafloor spreading and transform faults in the considerations of the development of the theory of plate tectonics. Historians can figure out which people deserve priority, but the Coats, Oliver and Isacks, and Isacks et al. papers were the ones that were important to me. It is, perhaps, also a matter of some significance that all three of these papers were in publications of the American Geophysical Union.

References

Coats, R. R., Magma type and crustal structure in the Aleutian arc, in *Crust of the Pacific Basin, Geophys. Monogr. Ser.*, vol. 6, edited by G. A. MacDonald and H. Kuno, pp. 92–109, AGU, Washington, D.C., 1962.

Doe, B. R., Cenozoic volcanism in the southern Rocky Mountains, *Q. Colo. School Mines, 63*, 149, 1968.

Isacks, B., J. Oliver, and L. R. Sykes, Seismology and the new global tectonics, *J. Geophys. Res., 73*, 5855, 1968.

Oliver, J., and B. Isacks, Deep earthquake zones, anomalous structures in the upper mantle, and lithosphere, *J. Geophys. Res., 72*, 4259, 1967.

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The Lehmann Discontinuity

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Recent reflections by Inge Lehmann on her discovery of the inner core (*Eos*, January 20, 1987, p. 33; see also *Bolt* [1987, 1982]) remind us that this outstanding Earth scientist is now in her 100th year. The inner core boundary (ICB) is one of the three great seismic-compositional discontinuities that divide Earth into crust, mantle, core, and inner core. The other two discontinuities are well known by names honoring their discoverers, Andrija Mohorovicic and Beno Gutenberg. In this tradition, it is fitting that the ICB be called the Lehmann Discontinuity in honor of its discoverer.

This title was used informally with respect to a discontinuity in the mantle at 190–250 km [*Anderson*, 1979, 1981]. Lehmann's work on discontinuities in the upper mantle stems from 1959 and later, but she proposed the inner core model in 1936. The use of her name for features of the upper mantle has been sparse. Precedence should be accorded the earlier and more fundamental discovery of the inner core, which is surely a feature of central importance in the dynamic Earth. We therefore consider that the name Lehmann Discontinuity is most appropriate for the inner core boundary.

References

Anderson, D. L., The deep structure of the continents, *J. Geophys. Res., 84*, 7555, 1979.

Anderson, D. L., Discontinuities in the mantle (abstract), *Eos Trans. AGU, 62*, 1073, 1981.

Bolt, B., *Inside the Earth*, W. H. Freeman, San Francisco, 1982.

Bolt, B., 50 years of studies on the inner core, *Eos Trans. AGU, 68*, 73, 1987.

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