

Memorial to Seitaro Tsuboi

1893–1986

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Seitaro Tsuboi was professor of petrology in the Imperial University of Tokyo (renamed the University of Tokyo after World War II), and a most prominent Japanese geologist from the 1930s to the 1950s. He is internationally remembered for his research in the optical identification of plagioclases and on the course of crystallization of pyroxenes from basaltic and andesitic magmas.

He was born in Tokyo on September 8, 1893, the first son of Shogoro and Nao Tsuboi. At that time, his father, Shogoro Tsuboi, was professor of anthropology in the Imperial University of Tokyo. In 1914 Seitaro Tsuboi matriculated in the Imperial University of Tokyo to study geology under Bundjiro Koto (petrologist) and Matajiri Yokoyama (paleontologist). Tsuboi specialized in petrology under the supervision of Koto.



In the 1630s the Japanese government adopted a policy of almost completely secluding the country from the outside world, banning not only migration of people to and from, but also communication and trade with, foreign countries. This policy was maintained for more than 200 years, until the 1850s. The University of Tokyo was founded in 1877 to introduce Western civilization. The university had a department of geology from the beginning. For the first eight years, German geologists taught there. Koto was the first graduate from the department of geology, and he went to Germany for further study. There he learned microscopic petrography under Ferdinand Zirkel at Leipzig. He came back to Tokyo in 1884, and became one of the first-generation Japanese professors in geology.

In 1917 Seitaro Tsuboi graduated from the Imperial University with a bachelor's degree and became an assistant to the two professors. He was promoted to associate professor in 1921 in the same university and then succeeded Koto. He received a Doctor of Science degree from the University of Tokyo in 1926. He was promoted to full professor in 1928 and taught optical mineralogy and igneous petrology.

In 1921–1923, Tsuboi was sent abroad by the Ministry of Education. During this period, he stayed mainly in the geophysical laboratory of the Carnegie Institution of Washington, and in the mineralogy laboratory of the University of Cambridge in England.

He retired from the University of Tokyo in 1954 and was granted the title of professor emeritus. He was director of the Thermal Spring Research Institute of Okayama University in western Japan from 1954 to 1959. In addition, he was director of the Tokyo Science Museum from 1939 to 1945. He died at the age of 93 on September 22, 1986, in his home in Tokyo.

Tsuboi was awarded the Imperial Prize of the Imperial Academy in Tokyo (1934), and was elected to membership in the academy in 1942. In 1978, the government of Japan awarded him an especially highly honorable title, *bunka-koroshi* ("Nominated Person of Cultural Merits"). He was president of the Geological Society of Japan (1944–1946), and he was elected to honorary fellowship of the Geological Society of America (1951), and to honorary memberships in the Volcanological Society of Japan (1957), Mineralogical Society of Japan (1962), Japanese

Association of Mineralogists, Petrologists, and Economic Geologists (1965), Geological Society of Japan (1968), and Tokyo Geographical Society (1981).

He was eager to protect the freedom of education and research even in the politically and socially repressive days during World War II. He was a cultural liberalist throughout his life.

In 1924, Seitaro Tsuboi married Yuri Hirayama, whose father was Shin Hirayama, professor of astronomy in the Imperial University of Tokyo. They had two sons, Masamichi and Naomichi, and a daughter, Nobuko. Yuri Tsuboi died on January 11, 1993. Masamichi Tsuboi is now professor emeritus of the University of Tokyo. Naomichi Tsuboi is a civil engineer.

Tsuboi's major scientific contributions may be classified into two groups, the use of the polarizing microscope and optical mineralogy, and igneous petrogenesis.

He maintained a strong interest in the polarizing microscope and optical mineralogy. Problems in optical mineralogy were his favorite subjects even in lunchtime chats. He improved the immersion method so that each of the main refractive indices of biaxial crystals could be determined. He proposed to use a dispersion method (based on a continuous change of the wavelength of light) on cleavage flakes of plagioclases for determination of the composition of the mineral. Later he simplified this method by use of a straight-line dispersion diagram (so-called Hartmann's dispersion net). He pointed out that the widely used diagram for the symmetrical extinction angles of albite-twinned plagioclases was wrong in principle, an important criticism ignored in the mineralogical literature because it was published in a journal of extremely limited circulation. He further pointed out that in the rectangular diagram showing the values of $2V$ as ordinate against the compositions of a solid-solution mineral as abscissa, if the value of $2V$ passes through zero, the curve of $2V$ should cut the abscissa perpendicularly there.

In his student days Tsuboi was fascinated by N. L. Bowen's early papers. He participated in the refinement of Bowen's theory of igneous petrogenesis and tried to apply it to Japanese volcanic rocks. He became personally acquainted with Bowen during his stay in the Carnegie Institution's geophysical laboratory in the early 1920s.

Tsuboi pointed out that bulk-rock chemical analyses of porphyritic igneous rocks do not represent the compositions of their magmas, but of mixtures of magmas and phenocrysts. He emphasized that the paragenetic relations of plagioclases and associated mafic minerals in igneous rocks are a useful criterion for tracing the process of their formation. Thus, he proposed to use a rectangular diagram showing the Ab percentage of plagioclase as abscissa and the refractive indices of associated mafic mineral as ordinate. He named genetic discussions based on this diagram "optical analysis of rocks." He discussed the course of crystallization of pyroxenes from basaltic and andesitic magmas, largely on the basis of petrographic data from Japan. He focused his attention on a difference in the compositions of pyroxenes between the phenocryst stage and the groundmass stage of crystallization. He revised his view as further progress was made.

In Japan Tsuboi made major contributions to geologic education by his well-written textbooks in optical mineralogy, igneous mineralogy, and igneous petrogenesis.

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