Looking for Glass from Hiroshima and Nagasaki

To the Editor:

I am attempting to locate glass from known positions at Hiroshima and Nagasaki to determine neutron doses using induced fission tracks caused by the nuclear weapons in 1945. I would appreciate help from anyone who knows of appropriate material.

Reliable numbers are important to society since permissible neutron exposures to human beings are based on the experience at Hiroshima—where the bomb sent more neutrons to significant distances than was the case at Nagasaki. It is remarkable that 48 years form the explosions that neutron dosimetry is still highly uncertain[1]—by factors of 1.6 at ground zero and of 8 at 1.5 km from the detonation point at Hiroshima!

Because of its usual uniformity, glass is a particularly simple, reliable detector of neutron-induced fission, which is recorded as radiation-damage tracks. As pointed out in 1987,[2] etched tracks in glass of conventional uranium content (~0.3 parts per million) could allow thermal neutron fluences to be measured to ~1 km from the epicenters at Hiroshima, with the sensitivity being proportional to the trace uranium concentration within the glass. Higher uranium content would allow dosimetry to greater radial distances. It is distressing to realize that well-documented samples would have been easy to locate in 1945. Unfortunately, the use of glass for track-based neutron dosimetry was not recognized for 20 years.[3] Nevertheless, the opportunity still exists in principle, and I am attempting to prod people's memories in the hope of improving our knowledge of the health effects of neutrons.

Although many other materials, including plastics and dielectric crystals, also record tracks, glass is so ubiquitous in modern society and simple to study that it is clearly the first choice. Appropriate substances are windows, lamps, decorative glass, glass electrical insulators, instrument covers, bottles, drinking glasses, auto windshields and headlights, glass display racks, refrigerator shelves, eyeglass lenses, and the surface layers of porcelains. Despite the possibilities being almost countless, the overriding obstacle to this project is the limited quantity of material whose position just prior to the detonations is established.

The glazed overlayers of tiles are also candidate materials. Samples were kindly sent to me by Drs. T. Nagatomo and M. Hoshi, but unfortunately my attempt to reveal the stored tracks failed because the combination of low uranium and considerable structural non-uniformity conspired to make track scanning slow, laborious, and consequently not very reliable.

Material that was melted by radiation from the explosion is also an unlikely storer of neutron-induced tracks, unless only a thin enough layer was melted as to be rapidly cooled between the moment of the electromagnetic burst and the slightly delayed arrival of the neutrons.

In principle, the high uranium content that characterizes many of the minor accessory minerals in certain rocks makes them sensitive detectors of neutrons. Examples of such minerals are zircon, apatite, and sphene, which are common constituents of granites. Geoscientists are aware, however, of spontaneous fission of ^{238}U. In any old detector material that contains uranium, this process stores tracks that are useful in determining ages of minerals, but they impede dosimetry by preloading samples with a background of such tracks. Only if it is known that natural minerals were sufficiently heated prior to the neutron exposure (so that tracks were annealed out), can minerals serve as convenient neutron dosimeters for the present purposes. At distances of greater than 2 km from ground zero, spontaneous fission tracks are expected to outnumber those from neutron-induced fission.

Uniform, well-located glasses from within ~1.6 km of ground zero are the material of choice. If you know of such material, or can direct me to someone who might, I would welcome communication by phone, (518) 276-8523, by fax (518) 276- 8627, or by letter: Rensselaer Polytechnic Institute, Department of Earth and Environmental Sciences, West Hall G-17, Troy, New York 12180-3590.

Robert L. Fleischer
Rensselaer Polytechnic Institute

1. K. Shizuma, K. Iwatani, H. Hasai, M. Hoshi, T. Oka, H. Morishima, "Residual ^{152}Eu and ^{60}Co Activities Induced by Neutrons from the Hiroshima Atomic Bomb," *Health Physics* **65** (3) (1993) p. 272–282.

2. R.L. Fleischer, "Serendipitous Dosimetry—An Opportunity and an Opportunity Lost," *Health Physics* **52** (2) (1987) p. 219–221.

3. R.L. Fleischer, P.B. Price, and R.M. Walker, "Neutron Flux Measurement by Fission Tracks in Solids", *Nucl. Sci. Eng.* **22** (1965) p. 153–156. □

https://doi.org/10.1557/S0883769400036460 Published online by Cambridge University Press