

"Komsomolets" – the sunken nuclear submarine in the Norwegian Sea – a possible environmental problem?

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Abstract

On 7 April 1989 the Soviet nuclear submarine "Komsomolets" sank in the Norwegian Sea about 185 km southwest of the Bear Island at bottom depth of about 1700 m. Potential sources of radioactive contamination are the reactor and the nuclear warheads.

A Komsomolets Foundation has been established consisting of the Russian constructor of the submarine, a Dutch salvaging consortium and some environmentally oriented parties. The goal of this foundation is to get international financial support for its plans to either salvage the submarine totally, to salvage the torpedo part or to seal off the torpedo part of the submarine. A report from an expert working group to Norwegian Minister of Foreign Affairs, however, concludes that the best solution is to leave "Komsomolets" where it is.

Radioactive components in the wreck which may be dissolved and spread in the water masses, include cesium-137 and strontium-90. Insoluble plutonium will settle in the sediments and remain in the vicinity of the wreck. The present study is dealing with the most likely pattern of the distribution of radioactive elements in the water masses if a leakage from the wreck occurs. The study is based on hydrographic observations, current measurements and numerical models.

By assessing the potential radioactive pollution from "Komsomolets", it is concluded that the sunken nuclear submarine represent a minor radioactive pollution problem for the following reasons:

- the great depth where the possible release of radioactive material will take place,
- the relatively small amount of radioactive material available for release,
- the enormous water masses available for dilution,
- the additional "chemical /biological dilution" (the radioactive isotopes of strontium and cesium are only a very small fraction of the total amount of these elements in sea water. The biological uptake will reflect this ratio between the radioactive and the non-radioactive isotope)
- the relatively biologically inactive plutonium will be confined to particulate form in the sediments close to the release point

The distribution of possible radioactivity in the water masses will be along isopycnic surfaces. The radioactive components will be spread by the pulsating current in the area, but they will remain in the deep water and gradually be diluted as they are dispersed from the source. It is not likely that watermasses to any measurable extent will rise from the depth of about 2000 m to the surface. If so, the concentration will only be a small and insignificant fraction of the content near the wreck. Even assuming that the submarine might represent a 10 MWatt heat source, a hot plume possible containing radioactive material, would rise to a maximum height of about 500 m above the bottom. The radioactive components will therefore gradually be dispersed in the deep water masses of the Nordic Seas and the Arctic Ocean, which has a volume in the order of 10 million km³. The deep water which is advected out of the area,

flows as bottom water across the deeper passages in the Greenland-Scotland Ridge to sink into the abyssal depths in the Atlantic from where it spreads in the deep circulation of the world oceans. Residence time in this system is assessed to range from a few to about 15 centuries.