



2.5 ANCIENT ATMOSPHERE - VALIDITY OF ICE RECORDS*

Z. Jaworowski

Central Laboratory for Radiological Protection

This laboratory was studying, for many years, the historical changes and geographical distribution of pollution of the global atmosphere with heavy metals and natural and man-made radionuclides. For these studies the ice samples collected from ten glaciers between Spitsbergen and Antarctica were used as a matrix, as it represents the cleanest parts of the surface of the planet. The experience gained in these glacier studies enabled us to assess the validity of ice core records of greenhouse gases, which are widely used as proof that, due to man's activity, the current atmospheric levels of CO₂ are higher by 25%, of CH₄ by 115%, and of N₂O by 19%, as compared with the pre-industrial and ancient atmosphere. During the last decade, these records became the basic input parameters in the models of the climatic warming hypothesis. However, no study has ever directly demonstrated that the content of greenhouse gases in air recovered from air bubbles in old polar ice, or even from recently deposited snow, represents the atmospheric composition. Concentrations of CO₂ of 135 ppmv, found in the recent firm near the surface of polar ice sheet, much lower than in the atmosphere (about 350 ppmv), and very high (up to 2450 ppmv) in the pre-industrial ice, indicate to the contrary. The wide range of CO₂, N₂, O₂ and noble gas concentrations in air bubbles from pre-industrial ice do not represent the atmospheric reality, but is, rather, due to fractionation of gases in ice sheets and in the ice cores caused by many physical and chemical processes.

The fractionation of atmospheric gases in ice sheets has been observed since the beginning of CO₂ studies in ice in the 1950s. Since about 1985, however, fractionation has been ignored or downplayed by arguments unsupported by experimental studies, and the ice core analyses are interpreted as directly representing the atmospheric composition.

In early publications CO₂ concentrations recorded in the bubbles from pre-industrial and ancient ice were often higher than in the present atmosphere. After 1985, however, the high values were not published.

Recently Jaworowski et al. (1990 & 1992) emphasized that about twenty physical and chemical processes in polar snow and ice may cause important changes in composition of air trapped in the ice. The glacier studies of greenhouse gases, which are fundamental for one of the most important global issues of the century, were never critically evaluated except for the above cited publications.

The quality of the ice cores as a material for reconstruction of the past atmospheric composition is questionable. The air bubbles from the polar ice cores do not fulfill the absolutely essential closed system criterion mainly due to the presence of liquid water in polar ice down to the eutectic temperature of -

73°C. Also inherent cracking of ice cores due to sheeting phenomenon during decompression of cores opens the routes of migration of gases in and out of the cores. The value of -280 ppmv, widely accepted from glacier studies for the pre-industrial atmospheric CO₂ level, apparently results from invalid assumptions, processes in ice sheets, artifacts in ice cores, and arbitrary rejection of high readings. To date, glaciological studies are not able to provide a reliable reconstruction of greenhouse levels in the pre-industrial atmosphere.

References

Jaworowski, Z.: T. V. Segalstad & N. Ono: Do glaciers tell a true atmospheric CO₂ story? *The Sci. Tot. Environ.* **114**: 227-284 (1992)
 Jaworowski, Z.: S. T.V. Segalstad & V. Hisdal: Atmospheric CO₂ and Global warming: a critical review. *Norsk Polarinstitutt, Rapportserie Nr. 39*, pp. 75 (1990)

* Published in: *Environmental Science and Pollution Research*, 1(3), 161-171, 1994.



PL9702354

**2.6 STIMULATORY EFFECTS OF IONIZING RADIATION:
 NEW ISSUE FOR REGULATORY POLICY***

Z. Jaworowski
 Central Laboratory for Radiological Protection

Since 1959 the International Commission on Radiological Protection (ICRP) based its rules on an assumption that the relationship between the dose and effect is a straight line, so that even a dose close to zero has some detrimental effect (ICRP, 1959). This assumption is called the "linear hypothesis" which states that there is no dose threshold or a limit below which the effects observed at high doses cease to appear. The "effects" in this hypothesis are assumed to be only the detrimental ones, such as decrease in life duration, occurrence of cancers and genetical damage. It also implies that no new effects occur at low doses.

Over the years the working assumption of ICRP of 1959 came to be regarded as a scientifically documented fact by the mass media, public opinion, regulatory bodies and even many scientists. The no-threshold principle, however, belongs to the realm of administration and it is not a "scientific" principle.

At the time the no-threshold hypothesis became the backbone of the philosophy and policy of radiation protection, the main scientific evidence came from epidemiological studies of atomic bomb survivors in Hiroshima and Nagasaki who were irradiated with doses up to about 6000 mSv. These studies