

THE ABSORBED DOSE IN TOOTH ENAMEL BY ^{90}Sr BODY BURDEN

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SUMMARY

The residents of the villages along the Techa river, Southern Urals, Russia, were exposed mainly external by γ -rays from ^{137}Cs and internal by β -rays from ^{90}Sr and its daughter ^{90}Y , as a result of the heavy release of radioactive waste from the plutonium production facility Mayak into the Techa in 1950-51. The residents living at the lower part of the river were exposed only little externally but mainly internally due to their ^{90}Sr body burden. Teeth from the latter group of residents which were extracted in 1994-95 in the course of dental care were collected and used for retrospective dosimetry more than 40 years after the main ^{90}Sr ingestion.

The absorbed dose in the enamel of the teeth was measured by EPR dosimetry. In addition the ^{90}Sr content in the roots of the teeth was measured by low-level beta counting. Both measurements at the teeth were done in 1995. The whole-body burden of the tooth donors was measured via bremsstrahlung in 1992-1994. The absorbed dose in the enamel of molars was found to correlate with the retained ^{90}Sr whole-body burden (Fig. 1). The equivalent dose in the enamel of the molars per ^{90}Sr body burden retained 42 years after the ingestion was determined to $3 \cdot 10^{-5}$ Sv/Bq. The accumulated background dose in the enamel of the in average 60 years old residents was found to be about 100 mSv. This results in an average annual dose rate for the background radiation of 1.7 mSv/a. The results suggest that the absorbed dose measured in the enamel of molars can provide information about the ^{90}Sr burden as a mean of the whole skeleton. In contrast to the encouraging results obtained from the dose measurements in the enamel of molars, no correlation with the ^{90}Sr body burden was found for the dose measured in the enamel of incisors. Similar discrepancies with dose measurement in the enamel of incisors were found earlier by other authors also in the case of predominantly external radiation. At present the reasons for these difficulties are not known but might be due to stronger sensitivity to environmental influences and/or problems in preparing the very thin layers of the enamel of incisors for the EPR measurement. Until these problems are resolved we recommend to exclude measurements of the enamel of incisors for retrospective EPR dosimetry.

No correlation could be found for the absorbed dose in the enamel of neither molars nor incisors with the ^{90}Sr content in the dentine of the roots of the teeth (Fig. 2). Due to the short range of the β -rays from ^{90}Sr and its daughter ^{90}Y , the dose in the enamel is expected to result predominantly from the ^{90}Sr content in the adjacent dentine within the tooth crown and less from the content in the root dentine. The results of the present investigation let suppose that the strontium metabolism in the dentine of the crown is comparable with the that of the mean of all parts of the skeleton. In contrast to the dentine of the root which is under extreme mechanical strain and hence remodels strongly. Therefore, measurements at the root dentine are not expected to provide conclusive information about the ^{90}Sr burden of the overall skeleton.

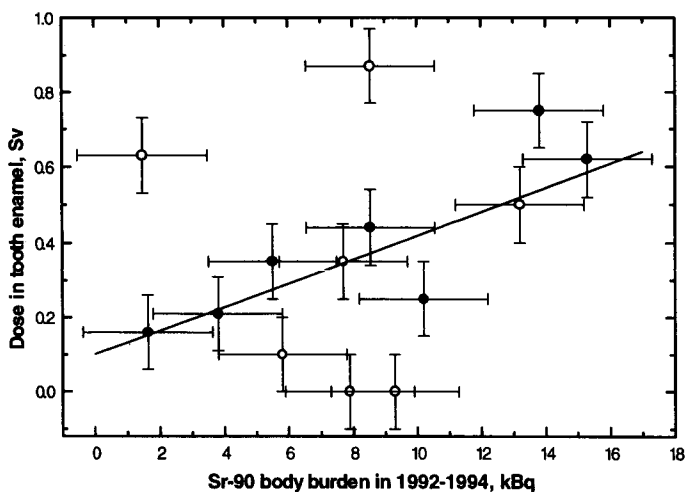


Figure 1. The absorbed dose in tooth enamel as measured by EPR dosimetry versus the ^{90}Sr whole body burden. The dose in the enamel from molars (●) were found to correlate with whole body burden. No correlation is obvious for the dose in the enamel of incisors (○) with the whole body burden.

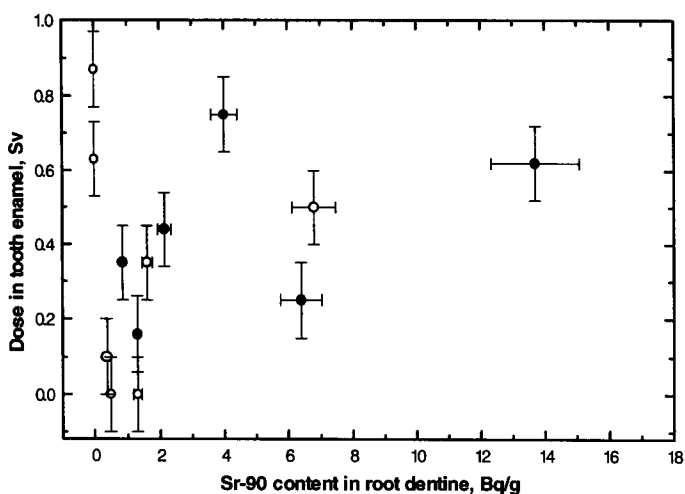


Figure 2. The absorbed dose in tooth enamel as measured by EPR dosimetry versus the ^{90}Sr content in the root of the tooth. The dose in the enamel from molars (●) and incisors (○) were found to correlate not strongly with the ^{90}Sr content in the root.

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