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A Biosphere Assessment: Influence due to Geosphere-Biosphere Interfaces

Youn-Myoung Lee*, Yongsoo Hwang
Korea Atomic Energy Research Institute, 150 Dukjin, Yuseong, Daejeon 305-353, **ymlee@kaeri.kr*

1. Introduction

Recently the geosphere-biosphere interfaces (GBIs), which is recognized as a zone (GBIZ) beyond the simple conceptual boundaries between the geosphere and biosphere modeling domains for safety assessment, has been raised to an important issue for the biosphere assessment. For the licensing process of the repository, the final step of a series of safety and performance assessment should be concerned how nuclides released from the geological media could make their farther transfer in the biosphere giving rise to doses to humans. Unlike in the case of geosphere, the distinct characteristics of biosphere modeling includes the potential release and subsequent exposure taking place not in the near future with rather unreliable predictions of human behavior at the time of its release. And also unlike the near- and far-field of geospheres such as near-field engineering structures and natural geological media, the biosphere is not conceived as a barrier itself that could be well designed or optimized, which always causes the necessity of site-specific modeling approach as much as possible. Through every step of whole geosphere and biosphere modeling, nuclides transport from various geological media to the biosphere over the GBI, biosphere modeling can be done independently, not even knowing what happens in the geosphere, making access possible to it in a separate manner, even though, to some extent, it might somehow need to be accounted for geosphere transport, as is similarly being currently done in many other countries. In general, to show the performance of the repository, dose exposure to the critical group due to nuclide release from the repository should be evaluated and the results compared to the risk or dose presented by regulatory bodies, as safety and performance criteria for HLW repository are usually expressed in terms of quantitative risk or dose. For a real site-specific treatment and incorporation of geological features such as aquifers into the biosphere models it is necessary to treat properly all the relevant FEPs and scenarios associated with the organically coupled chain between the modeling schemes of groundwater flow and nuclide transport in the geosphere and biosphere. Since the first development of a biosphere assessment model and the implemented codes, ACBIO[1] and ACBIO2, which has more complex modeling scheme than its predecessor, based on BIOMASS methodology by utilizing AMBER[2] for the purpose of evaluating dose rate to individual due to the long-term release of nuclides from the HLW or LILW repositories, a couple of their successors have been further developed and finally migrated to GoldSim[3] scheme which is more flexible to adopt complex nuclide behaviors between the geosphere and the biosphere than AMBER based ACBIOs and then currently is being implemented into a GoldSim total system performance assessment programs[4,5] which is being developed for the total safety assessment of the radioactive waste repository. To show its practicability and usability as well as to see the importance of GBIs, a quantified influence of the biosphere assessment has been investigated for varying GBI schemes through this study. To this end, among a few other possibilities, two cases having a different GBI scheme, the first one of which is “Aquifer-only” GBI and the other one is “All-possible GBIs”, they have been evaluated and compared with each other. Two plots for the calculated results are represented in Figs. 1 and 2 where peak dose conversion factors only for farming exposure group due to 38 nuclides are shown. As shown in Fig. 1, which represents the case of “Aquifer-GBI” only, some discrepancy is found for such selected nuclides as ^{79}Se and ^{135}Cs between the cases of “existence of a well” through which groundwater in the aquifer is drawn for the farming usage. However, unlike the farming

exposure group no other two exposure groups, freshwater exposure and marine water exposure groups, seem to be free from the same scheme. However, all the exposure groups are influenced by the other GBI scheme, which is the case all possible surface and subsurface water bodies, such as aquifer, river water and marine water that are incorporated in the GBIs, showing some discrepancy for almost all the nuclides even though exposures for two other exposure groups are not shown in Fig. 2., which means GBI scheme is very important and it should be carefully treated and modeled for the biosphere modeling.

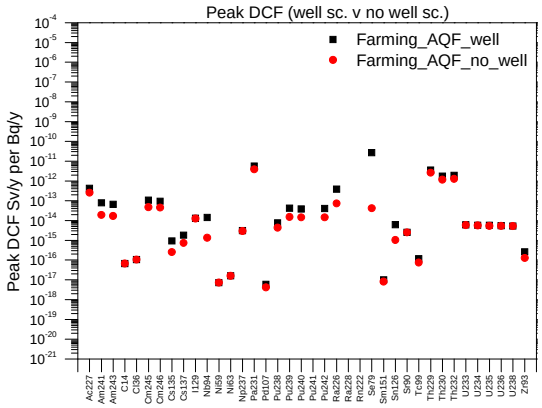

Fig.1. Peak dose conversion factors for farming exposure group due to 38 nuclides in case of Aquifer-GBI which show slight discrepancy for several nuclides by well existence.

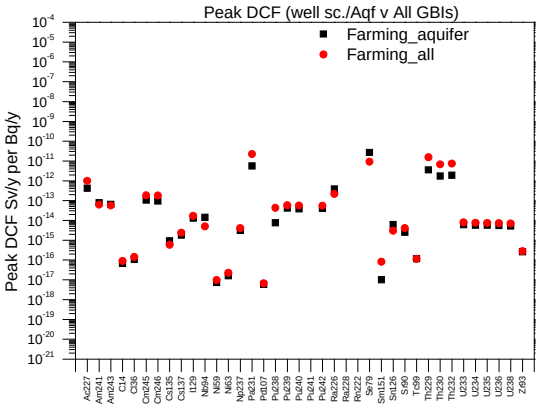

Fig.2. Peak dose conversion factors for farming exposure group due to 38 nuclides for well-GBI, compared with All-GBIs.

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