



Relationship between $^{210}\text{Pb}_{ex}$ and soil characteristics in Mediterranean hillslope

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Natural occurring fallout ^{210}Pb (half live, 22.2 yr) offers the potential for use as a radiotracer of soil movement in a similar manner to ^{137}Cs in diverse agricultural landscapes of the world. The purpose of this study was to investigate the content of $^{210}\text{Pb}_{ex}$, physico-chemical soil properties and physiographic factors of Mediterranean mountain hillslopes in order to infer the relationship between these properties analyzed in selected cultivated and undisturbed soils. The study area is located in a subhumid Mediterranean agroecosystem in the central part of the Pyrenees. Along two hillslope transects a total of 31 soil cores were collected with different land uses, soil types, lithologies, altitude, orientation and slope gradient.

The $^{210}\text{Pb}_{ex}$ mass activities ranged between 0.8 and 54.7 Bq kg^{-1} and the $^{210}\text{Pb}_{ex}$ inventories varied between 318 and 7298 Bq m^{-2} . The Anova test indicated significant differences in the mean of $^{210}\text{Pb}_{ex}$ mass activities for different land uses and ranges of altitude, while significant differences were found in the mean of $^{210}\text{Pb}_{ex}$ inventories for different land uses, slope gradients, ranges of altitude and different soil types. Significant positive correlations were found between $^{210}\text{Pb}_{ex}$ mass activity and total organic carbon (TOC) and stoniness, respectively, but inverse relation was observed with clay content despite expected. Nevertheless, when differentiating between land uses, in uncultivated soils the correlations decrease and in cultivated soils no significant correlations were found. On the other hand, no significant correlations were found between the $^{210}\text{Pb}_{ex}$ inventories and soil properties analyzed. Principal component analysis (PCA) and Cluster analysis were used to generate a hypothesis that the distribution pattern of radioisotope was influenced by the variation in soil properties and physiographic factors. PCA results showed that TOC, stones and altitude were the major soil factors responsible for variations of $^{210}\text{Pb}_{ex}$ mass activity in soils. The Cluster analysis showed results similar to PCA. Furthermore, a preliminary regression and GLM models have been developed in order to infer the content of $^{210}\text{Pb}_{ex}$ in soils based on sets significant soil properties more easily measurable. However, more data would be required to develop robust models.

These relationships can be used to determine the approximate content of $^{210}\text{Pb}_{ex}$ in Mediterranean soils. The results suggest that the content of $^{210}\text{Pb}_{ex}$ in soils is strongly affected by land use and TOC content. Further research has to be done for better understanding the role of soil properties in the distribution of $^{210}\text{Pb}_{ex}$, which is relevant for applying $^{210}\text{Pb}_{ex}$ to assess soil erosion in Mediterranean agroecosystems.