# EVALUATION OF TRACE ELEMENTS IN LUNG SAMPLES FROM COAL MINERS USING NEUTRON ACTIVATION ANALYSIS

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Miners are considered as one of the critical groups for occupational lung diseases due to the inhalation and exposure to toxic substances. Consequently, the determination of trace elements in lung tissues is very important to identify elements responsible for pathological effects.

In this study, instrumental neutron activation analysis (INAA) has been applied to determine Sc, Hf, U, Th and lanthanide elements in lung samples from coal miners in order to compare with those results obtained for normal individuals. This class of elements was chosen for the analyses because most of Brazilian coal samples have presented a relatively high content of Th and lanthanide elements.

Lung samples were collected in autopsies of workers from a coal mine located in Criciuma, Santa Catarina, Brazil. Normal lung samples were collected in autopsies of healthy people performed at the Institute of Forensic Medicine of the University of Sao Paulo.

INAA method applied in these determinations consisted of irradiating the dried lung samples together with the synthetic standards of elements with thermal neutron flux of $10^{12}$ n $cm^{-2}$ $s^{-1}$ of the IEA-R1 swimming-pool type research reactor, for a period of 10 hours. After adequate decay times, gamma ray measurements were carried out using a hyperpure Ge detector. Concentrations of the elements were calculated by comparative method. Analytical quality control of the results was also evaluated by analysing reference materials: USGS W-2 Rock and NIST 1575 Pine Needle. Geological reference material was also analysed because certified values for U, Hf and lanthanide elements in biological reference materials are very scarce. The contribution of the fission products of uranium in the analysis of La, Ce, Nd and Sm was also considered by determining experimentally the interference correction factors.

The following ranges of elemental concentrations, in μg/Kg of dried lung sample, have been obtained:

Lungs from coal miners: Sc (13 - 830), La (75 - 2871), Ce (273 - 5481), Nd (40 - 2453), Sm (7 - 473), Eu (2.9 - 76) Tb (3.1 - 68), Yb (0.9 - 215), Lu (1.0 - 37), Hf (5.9 - 287), Th (12.3 - 892) and U (8.7 - 356).

Lungs from healthy individuals: Sc (1.2 - 3.8), La (20 - 74), Ce (112 - 259), Nd (62 - 288), Sm (2.8 - 4.9), Eu (0.8 - 3.0), Lu (0.3 - 1.2), Hf (2.6 - 4.6), Th (6.1 - 18.9) and U (3.7 - 44). Tb and Yb were not detected in lungs from this group.

Results obtained in these analyses indicated a variability of elemental concentrations within a same group of individuals but lungs from coal miners presented concentrations of elements higher than those found for the control group. Little is known of biological effects of the lanthanides. These findings indicated that Sc, U, Th and lanthanide elements are absorbed and retained in the lungs and they also can be considered as elements responsible for pneumoconiosis disease as shown in the microscopic studies of lung tissues from coal miners.