

# PUBLIC HEALTH RISK ASSESSMENT ASSOCIATED WITH HEAVY METAL AND ARSENIC EXPOSURE NEAR AN ABANDONED MINE (KIRKI, GREECE)

**Christos Nikolaidis**, *Democritus University of Thrace, Greece*  
**Moysis Orfanidis**, *Democritus University of Thrace, Greece*  
**Stratos Mylonas**, *Democritus University of Thrace, Greece*  
**Theodore Constantinidis**, *Democritus University of Thrace, Greece*

**Background and Aims:** The “Agios Philippos” lead-zinc mine in the Kirki region (NE Greece) is now closed but its legacy of heavy metal contaminated land remains at the site (Loupasakis and Konstantopoulou 2009, Nikolaidis *et al.* 2010). A risk assessment approach was elaborated in order to address the potential adverse health effects associated with lead, cadmium, zinc and arsenic exposure.

**Methods:** Soil samples from the proximity of the mine were collected and analyzed using standard procedures (Chen *et al.* 2006). Risk assessment guidelines developed by US EPA were employed in order to assess exposures related to i) inhalation of dust particles, ii) dermal absorption of trace elements adhered to the skin and iii) soil ingestion (US EPA 1997). The average daily dose (ADD) was calculated taking into account both the carcinogenic and non-carcinogenic risk. The reference dose (RfD) for each element was used to yield a hazard quotient (HQ) of non-carcinogenic effects. The hazard index (HI) was then generated by summing up all individual HQs. A slope factor (SF) was used to calculate the carcinogenic risk (CR) for arsenic (IRIS 2009).

**Results:** The majority (69.2%) of samples approximating the source of heavy metal contamination produced an increased toxicological risk for arsenic and lead. The overall hazard index near the mine portal exceeded the accepted value (HI• 1) by 4.3-fold. An unacceptable carcinogenic risk for arsenic (CR> 1 x10<sup>-5</sup>) was evident near the contamination source, which gradually faded out with distance from the mine.

**Conclusions:** These findings indicate that heavy metal contamination in the “Agios Philippos” mine poses a significant risk to the exposed population (Kirki, NE Greece). These exposures have to be carefully evaluated at the biological level and validated by appropriate epidemiological methods before any further conclusions can be made.

## References:

Chen SB, Zhu YG and Ma YB (2006) The effect of grain size of rock phosphate amendment on metal immobilization in contaminated soils. *J Hazard Mater* 134: 74-79

IRIS – Integrated Risk Information System US EPA(2009) <http://www.epa.gov/iris>

Loupasakis C and Konstantopoulou G (2009) Safety assessment of abandoned tailings ponds: an example from Kirki mines, Greece. *Bull Eng Geol Environ* 69: 63-69

Nikolaidis C, Zafiriadis I, Mathioudakis V and Constantinidis T (2010) Heavy metal pollution associated with an abandoned lead-zinc mine in the Kirki region, NE Greece. *Bull Environ Contam Toxicol*. 85: 307-312.

US EPA - United States Environmental Protection Agency (1997) Exposure factors handbook. EPA/600/P-95/002F. Washington, DC: Environmental Protection Agency, Office of Research and Development.