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Metal mining and natural protected areas in Mexico: Geographic overlaps and environmental implications

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ABSTRACT

Because the high biodiversity of Mexico about 12% of the country's total area is included as a Natural Protected Areas (NPAs); however, in the last years, according to the official data, an astonishing number of mining concessions covering 28% of the total area of the country has been granted already. The objective of this work is to quantify the geographical overlap of mining concessions with the federal NPAs of Mexico including the exploration/exploitation status of minerals to be extracted. We use geo-referenced polygons of the NPAs and those of mining exploration and exploitation concessions until 2010 and calculated their overlap extension with the application of ArcView GIS 3.3 (ESRI; Redland, CA, U.S.A.). Our results showed that a total of 1609 mining concessions covering an area of 1,486,433 ha geographically overlaps with the NPAs. With the exception of Natural Monuments (NM), all the different categories of NPAs in Mexico showed mining concessions; 75% of Natural Resources Protection Area (NRPA); 63% of Biosphere Reserve (BR); 47% of Protected Area for Flora and Fauna (PAFF); 22% of Sanctuary (S); and 15% of National Park (NP). The impacts of metal mining activities on NPAs are not only limited to biodiversity and affectation to human communities, but they also have a radius of influence not yet evaluated since most of the NPAs have a special role in supplying watersheds and aquifers. Obviously, currently in Mexico a NPA decree does not represent an obstacle to megamining projects; in consequence, their real environmental impacts are underestimated. It is a priority to legally support canceling the mining concessions already granted in the NPAs and stop granting new ones in the future. In the proportion to which environmental authorities continue to

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openly accept mining concessions within the NPAs, through modifying management programs that allow these activities, they may cause a significant increase in rejections of local people toward the changes in management programs and on the promotion of new NPAs in Mexico.

1. Introduction

The great diversity of Mexico, one of the highest in the world, includes not only a large number of species, ecosystems and endemic species richness, but also a great genetic variability shown in many taxa (Llorente-Bousquets and Ocegueda, 2008; Pérez et al., 2009). Mexico boasts a biological richness of 10–12% of the world's species, of which only 42% is currently known (Llorente-Bousquets and Ocegueda, 2008). Within this biodiversity, distribution patterns of variables according to the heterogeneity of the Mexican physical environment are observed, which in turn is the result of a very complex geological and climate history (Díaz-Caravantes and Scott, 2010; Espinoza et al., 2008; Sarukhán et al., 1996).

The increase in global demand for minerals and strategic metals has raised the pressure for extraction in peripheral countries (Delgado, 2010; Ceseña, 2012). This pressure has reached ecologically and hydrologically sensitive areas and even protected areas. The World Resources Institute found that globally 75% of active mines and exploration areas overlap with areas of high conservation value and high water stress basins and more than 25% of active mines and exploration overlap with or fall within the radius of 10 km from a strictly protected area, and about a third of all active mines and exploration sites are located within ecosystems either intact of with a high conservancy value (WRI, 2004).

Few studies have been made in Mexico to know the overlap of mining sites and natural protected areas (NPAs) impacting on these last ones (Hernández-Arzate, 2012; López and Eslava, 2011). This kind of studies allowed generating valuable information as a tool for decision makers. Moreover, a country as Mexico, the world's first silver producer, ranks among the top 10 producers of 16 different minerals, and by 2013 an investment of nearly 8 billion dollars had been estimated according to the Mining Chamber of Mexico (SE, 2013b).

In the mid-1990s, the leadership of the World Commission on Protected Areas (WCPA) made a recommendation approved at the World Conservation Congress in Amman, Jordan in 2000, requesting all members of the International Union for Conservation of Nature (IUCN) status outlawed all exploration and extraction of mineral resources in categories corresponding to the management related to kinds I to IV protected areas (IUCN, 2004). From this meeting, as one of the main consequences in Mexico, the application of this recommendation in the Mexican Protected Natural Area (PNA) system would be explicit and clearly categorical to forbidding mining and exploration in the core of the biosphere reserves, sanctuaries, national parks, national monuments, and areas of wildlife protection (PNUMA, 2003). Although all members of IUCN in Amman approved the recommendation, it was strongly opposed by the U.S. government (Amman, 2000).

Later in 2003, the International Council on Mining and Metals (ICMM), composed of the world's largest mining companies, made the commitment not to explore or mine World Heritage Sites, which is a measure of self-regulation that may or may not be fulfilled; for example, its members also have as one of their principles, respect for human rights of the communities where they settle, and they have been accused of repeatedly violating them (e.g. Newmont Yanacocha Mine and Goldcorp with several mines listed in International Health People's Court, Tribunal de Salud, 2012).

One of the effects produced by metal mining is acid drainage. Water drags different heavy metals according to pH level, but acid drainage associated to sulfur compounds is often accompanied by arsenic, cadmium, copper, lead, and zinc (Wireman and Stover, 2011) also iron, manganese and aluminum (Johnson and Hallberg, 2005). In 1993 the US Forest Service estimated that rivers in the U.S.A. (5000–10,000 miles) were subjected to acid drainage (US EPA, 2000). It was recently mentioned that only in the Mid-Atlantic region about 4785 miles of streams with low pH have been impacted primarily by coal extraction (US Environmental Protection Agency, 2012).

Several studies have been made about mining pollution consequences in some areas in Mexico (Gómez-Álvarez et al., 2009; Herrera and González, 1995; Lizárraga-Mendiola et al., 2014; Méndez and Armienta, 2003). Considering the high biodiversity in the country, about 12% of its total area is declared as a protected area while under the astonishing rate of mining concessions granted in recent years, approximately 25% of the total area of all Mexico is now included within a mining concession (ASF 2010, 2012; López and Eslava, 2011); thus it is necessary to generate studies linking the NPAs of Mexico with mining concessions. Therefore, the aim of this work is to quantify the geographical overlap of mining concessions, including the status thereof and minerals to be extracted within federal protected areas of Mexico.

2. Materials and methods

For this paper, we analyzed geo-referenced polygons of Federal Protected Areas from the National Commission of Protected Natural Areas (CONANP, initials in Spanish) database by 2012 and geo-referenced polygons of mining exploration and exploitation concessions granted by the Ministry of Economy through the Federal Institute for Access to Information (IFAI) with information until 2010 (and is in effect on the date) were used.