Geomorphic Landform Design and Landscape Evolution Modelling for Mine Rehabilitation in Portugal and Spain (LIFE RIBERMINE PROJECT)

Ramón Sánchez[1], **José F. Martín Duque**[1], María Tejedor[1], Monica Martins[2], Ana Margarida Pereira[2], Alvaro Manuel Madureira Pinto[2], Jorge Manuel Rodrigues de Sancho Relvas[2], Gregory R. Hancock[3], Cristina Martín Moreno[1], and Javier de la Villa Albares[4]

[1]Universidad Complutense de Madrid, Spain

[2]Centro Ciência Viva do Lousal, Portugal

[3]University of Newcastle, Australia

[4]Regional Government of Castile-La Mancha, Spain

Mining is an essential activity in our society, as it provides the materials and metals essential to support our current life level and development. However, it also produces a high environmental impact wherever it occurs. The environmental impact of mining on landscape systems is well recognized. Surface mining imposes severe ecological effects on the land because alteration affects vegetation, soils, bedrock and landforms-landscapes. Surface hydrology and groundwater levels and flow paths are also changed. The science of geomorphology, which deals with the study of earth's landforms and the surface processes by which they are shaped, provides a useful framework both for an understanding of the environmental effects of surface mining, including changes in erosion–sedimentation processes and soil properties and for designing the most appropriate strategies for landscape reconstruction. Methods for landscape reconstruction based on geomorphic science have been developed and advanced in recent decades. New technologies have developed alongside the recognition of the environmental impact and resultant societal expectation of a rehabilitated and integrated post-mining system. A post-mining landscape requires physical stability (and, if present, chemical stability). Australia, United States, Canada, Chile and the European Union, among others, have mine regulations requiring physical and chemical stability and non-polluting post-mining landforms for mine closure. Physical stability can be guaranteed by expert Geomorphic Landform Design (GLD) and Landscape Evolution Modelling (LEM). In this framework, we describe the combination of GLD tools (GeoFluv – Natural Regrade and Talus Royal) with a LEM method (SIBERIA), and with Acid Mine Drainage (AMD) stabilization measures where they are needed. All that at the LIFE RIBERMINE project (https://liferibermine.com/en/homepage_en/), at two locations of the Iberian Peninsula (an ancient pyrite mine at Lousal, Portugal; and an abandoned kaolin mine at Peñalén, Spain). In conjunction, LIFE RIBERMINE is the first mine rehabilitation project, globally, which combines the GeoFluv – Natural Regrade (for geomorphic landform design of unconsolidated sandy waste dumps) and Talus Royal (for landform design of hard-rock residual highwalls). And within the European Union, it is the first mine closure project combining GeoFluv-Natural Regrade GLD with: (a) AMD chemical stabilization measures; and, (b) landscape evolution modelling to evaluate erosional stability of post-mining landform designs. This contribution describes the design and implementation of the referred methods, demonstrating that the science of geomorphology can have a key contribution to solve critical environmental problems derived from one of our most

needed economic activities (mining).