Assessment of land subsidence associated with intense erosion zones in the Zacatecas and Guadalupe quadrangles, Mexico

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Abstract We performed a geological and geomorphological analysis in the Zacatecas and Guadalupe quadrangles. The objectives are the assessment of the role of the erosion in land subsidence and its association with the lithology and geological structures. The stratigraphic sequence of the study area is composed, from bottom to top, of the dominantly sedimentary Zacatecas Formation (ZF, Early Cretaceous). It is covered in transitional contact by the Las Pilas Volcanosedimentary Complex (LPC, Early Cretaceous). The LPC is composed of laccolithic intrusions and basaltic lava flows interlayered with fine grained sedimentary rocks. The LPC is in contact by unconformity with the Paleocene-Eocene Zacatecas Red Conglomerate (ZRC), which is a polimictic conglomerate composed of clasts of the ZF and LPC. Strata in the ZRC vary from well- to barely-consolidated. At the top there is an Eocene-Oligocene volcanic sequence composed of ignimbrites and tuffs that varies from welded to moderately welded. These rocks have been subject to compression during the Late Cretaceous and at least five extension stages during the Cenozoic. Geomorphological analysis was performed with the dissection density, general dissection density, maximum dissection depth and relief energy maps. Field mapping was focused on paleo-landslides and talus deposits. Based on the field mapping we defined that where dissection density >10 km/km², general dissection density >25 km/km², maximum dissection depth >130 m and relief energy >160 occur together they locate intense erosion zones. In these zones, the land subsidence is developed if the rocks are moderately to poorly consolidated, in loose talus deposits or in poorly compacted sediments. The erosion is greater if there are faults and/or fractures. The identification of the high erosion zones associated with land subsidence is a tool to identify hazardous zones that could be applicable in urban planning projects.

Key words erosion zones; geomorphology; Zacatecas and Guadalupe, Mexico