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Geophysical Imaging for a Tailing Dam decommissioning: Serra Grande Tailing Dam – Goiás State-Brazil

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Introduction

Brazil is facing a unique challenge around the globe: Safely decommissioning of 74 tailings dams in less than a decade. After two tailings dams ruptures, Fundão and Brumadinho events, both located in Minas Gerais State- Southeastern Brazil, Brazilian Mining Agency (ANM) approved many changes in the mining regulation framework, including the mandatory decommissioning of upstream raising tailing dams. As per defined in the regulations, the company are the responsible for the safety of these structures in all the project stages: Planning, execution and post-execution (monitoring). Among the parameters to be considered in the decommissioning project, geophysics can support key ones, that are properly inferred by ground acquisition methods: Inference of the material stiffness that composes the crest, embankment, reservoir and abutments using active and passive Multichannel Analysis of Surface Waves (MASW).

Method and/or Theory

The Serra Grande tailing dam, the main site of this work, belongs to Serra Grande Mining Complex (MSG) and is located in the Crixás City, northern portion of the Goiás State, center-west region of Brazil. The Serra Grande tailings dam is a upstream raise dam with 92 m high, length of 1210 m, with an estimated volume of 17 Mm³, storing cycloned tailings, compacted and sterile particles in the silt-sandy fraction. The MASW (Multichannel Analysis of Surface Waves) active and passive techniques, infer the 1D structure of the seismic velocity Vs (S-wave velocity, from Shear Wave, translated as shear or transverse wave), being determined through geophones arrays. Each seismic base, spaced 2,5 m along each profile, gave rise to a 1D profile of Vs, with joint analysis of MASW-active and MASW-passive data (also known as the MAM-Microtremor Array Measurements technique). For this acquisition the field system allowed the creation of a 1D model of Vs every 60 meters along the lines and the mesh allowed the generation of a 3D model of the distribution of Vs in the body and tailings of the dam

Results and Conclusions

The 3D model of the MASW dataset allowed a detailed assessment of the Vs behaviour on the rupture plan, type sections and the first 30 meters of the dam. From the operational perspective, the knowledge about low Vs values, 180-200 in the first 15 meters of the reservoir indicates that vibration testing is key to define operational strategy to use machinery on the structure. Beyond the stiffness inferences, MASW will base the Ambient Noise Seismic Interferometry (ANSI) monitoring, since the Vs variation now has a measured baseline. The analysis made combining MASW and ANSI dataset generated many operational insights when compared with the instrumentation installed in the structure beyond the fact that now is clear that the ground operations are achieving the objective that, in general, is to increasing the stiffness of the structures.