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Understanding the progression of leaching in microwave treated particles using X-ray Computed tomography (XCT) analysis

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3D imaging and analysis of a multiphase particulate system by X-ray computed tomography (XCT) provides detailed information of interest in the analysis of hydrometallurgical operations. XCT is now widely accepted as a method to study particle damage during comminution operations and in investigating the nature of particle breakage. Using XCT it is possible to investigate the internal damage and cracks of ore particles of different sizes. This study utilises XCT to study the progression of leaching in microwave treated particles. The application of high power microwave energy to coarse heap leach feed has been shown to induce micro fractures and cracks in the ore. The objective of this study was to determine the effect of microwave induced cracks on the progression of leaching in single ore particles. Ore particles representing small (-5+4.75) mm, medium (-16+9.5) mm, and large (-25+19) mm sphalerite ore particles were microwave treated at specific microwave heating energies of between 1-3kWh/t. The microwave treated ore samples were packed in reactors in which the lixiviant was continuously circulated around stacked baskets containing ore particles for 350 days. XCT analysis was used to quantify the effect of microwave induced cracks on high density sulphide phase dissolution in individual crushed particles. From time to time the column leaching experiments were stopped to carry out XCT analysis on selected tagged particles from each leaching reactor.

The volume of sulphide grains and cracks in each individual particle at a certain time period was quantified using a combination of threshholding, segmentation and connected component analysis techniques. An object comparison tool in VGStudio Max image analysis software for determining changes in object structure over time was used to compare the voxel data sets of the particle before leaching with voxel data sets of the particle at different leaching periods (day 40, 140, 200, 300 and 350). This was done in order to investigate the loss of surface area during leaching at an individual particle level and to identify the role of microwave induced cracks in this process.

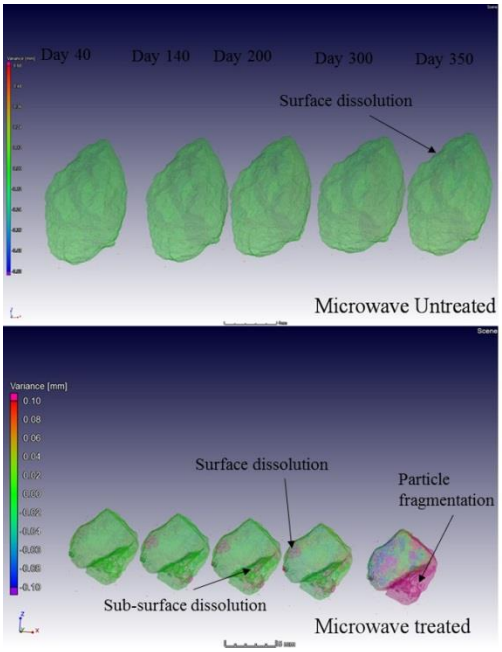

Figure 1: 3D colour coded variation maps of microwave treated and untreated small HPGR crushed particle over 350 days of leaching

Analysis of the 3D colour coded variation maps of microwave treated and untreated particles during the leaching period shows surfaces changes in the individual particle structure (see Figure 1). This variation is due to the depletion of minerals in the particle during leaching. The results suggest that the minerals near the surface are depleted first before the leach front migrates further into the particle (see Figure 1).