Mapping karst features and recharge pathways using resistivity imaging: A case study Wellington Caves, NSW, Australia

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Karst landscapes occupy 10% of the Earth's surface, and worldwide many communities rely on fresh water from karst aquifers. Knowledge of recharge pathways helps manage karst aquifers, however mapping recharge pathways in karst terrains remains a challenge. Modern multi-electrode resistivity imaging cables and improved signal noise reduction algorithms enable higher resolution resistivity images to be collected. In this study, we demonstrate the benefits of electrical resistivity imaging for mapping karst features and recharge pathways through the Garra Limestone, Wellington, NSW, Australia. Borehole lithological logs, groundwater level data, site geological knowledge, and previously mapped sinkholes and conduits were used to control the interpretation of the electrical resistivity images. Two types of anomalies are commonly observable in the resistivity images run over and adjacent to Wellington Caves. In the near-surface unsaturated zone electrically resistive air-filled joints and conduits form distinct anomalies beneath the low resistivity soils that overlie the limestone or fill the upper portion of sinkholes. In the saturated zone, conduits filled with low resistivity clay or water produce clear anomalies when surrounded by high resistivity limestone. The resistivity images highlight the position of previous unknown major conduits, which will be the target of future studies. Resistivity imaging has also delineated the paleochannel surface between the valley filling alluvial sediments and the thinly bedded limestone, and indicates potential pathways of interaction between the alluvial and karst aquifers. At Wellington Caves (a major tourist attraction) the alluvial aquifer to the west of the caves is used to supply groundwater for irrigated agriculture. It is therefore important to understand the interactions between the alluvial and karst aquifers to enable the best management of both sectors.