Virtual outcrop geology comes of age: the application of consumer grade virtual reality hardware and software to digital outcrop data analysis

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The rapid development of close range 3D (range) imaging techniques (e.g. terrestrial lidar and structure from motion-multiview stereo photogrammetry), coupled with a commensurate development geologically focused 3D point cloud and tetrahedral mesh analysis techniques has revolutionized outcrop studies over the past decade. Indeed, the deployment of digital outcrop data capture and analysis techniques is now relatively routine, and provides field geologists with the means to quantitatively interrogate 3D sedimentary, structural and diagenetic architecture exposed in outcrop. Despite these advances, the medium through which such datasets has been interpreted and analyzed has largely remained the same over the past decade, with workers utilizing flat panel displays to visualize and interrogate digital outcrop models. A recent upsurge in the availability of consumer grade virtual reality (VR) hardware and software offers great potential to geoscience practitioners to visualize and interpret digital outcrop datasets within a fully immersive environment. Harnessing such technology promises to fulfill the potential of digital outcrop datasets in providing a 'virtual' experience of fieldwork identified by early workers, but restricted hitherto by our reliance upon flat panel displays as a medium for visualization.

Despite their potential, a paucity of geologically focused software tools represents a major obstacle in the deployment if virtual reality systems for geological applications. In this work, the need for discipline specific analysis tools is addressed by harnessing a consumer grade virtual reality system (HTC Vive) and VR graphics package (Google Tilt Brush) to interactively interpret and analyze sedimentary and structural architecture (bedding contacts, faults, fractures) from digital outcrop models. Having generated these interpretations, users utilize a script library developed in the MATLAB language to extract geologically useful data (e.g. orientation, length, connectivity, intensity) from interactively generated 3D graphics objects.