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Jerome A. Bellian[1], David C. Jennette[1], Charles Kerans[1], James Gibeaut[1], John Andrews[1], Brad Yssldyk[2], David Larue[3] (1) The Bureau of Economic Geology at The University of Texas at Austin, Austin, TX (2) Optech, Toronto, ON (3) Chevron Petroleum Technology Company, San Ramon, CA

# 3-Dimensional Digital Outcrop Data Collection and Analysis Using Eye-safe Laser (LIDAR) Technology

New efforts to integrate critical ground truthing from outcrop data into the rapidly evolving world of digital subsurface mapping and exploration have taken significant strides in the last decade. LIDAR (LIght Detection And Ranging), a laser-based mapping tool developed for atmospheric studies in the mid-1960s, enables geologists to rapidly and accurately collect stratigraphic information directly from outcrops scanned with intensity-sensitive laser instrumentation. Light-ranging data is co-rendered with laser intensity data to generate 3D outcrop models with near zero distortion in x, y and z space. In addition, the intensity of the return signal helps to discriminate between different lithologic types. The results can be likened to black and white photography draped onto a 3D surface. Data acquisition can be done in any lighting conditions, with a rate of 2000 points per second. This instrument can achieve sub-centimeter range resolution with 16-bit intensity returns for each ranging point recorded. A 1 x 0.3 km outcrop face can be acquired and merged into a single point-cloud data set with corresponding intensity in less than two hours on a standard laptop computer. Case studies include deepwater carbonate and siliciclastic outcrops from West Texas and deepwater channel sandstones from northern Spain. These data are ideal for display and interpretation on workstation systems. Results are then directly imported into subsurface modeling software to measure and collect fine-scale bed-length data and to construct remarkably accurate architecture and lithofacies models.