

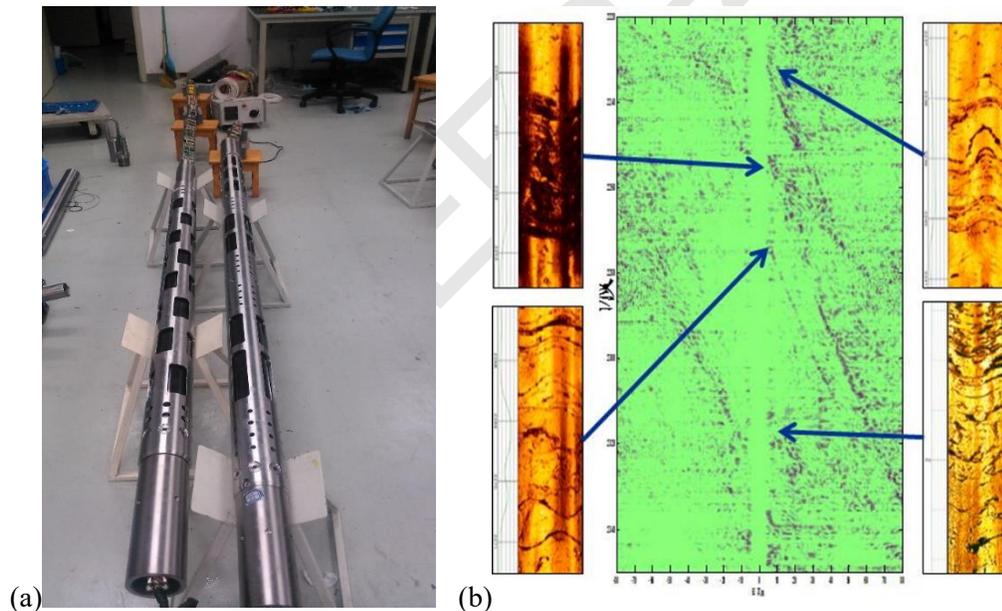
## Far distance acoustic imaging through a borehole

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Modern exploration for hydrocarbon-bearing reservoirs involves a basic need for information concerning subsurface structural features. Compared to the very limited radiation depths of traditional sonic logging, the single-well imaging technique is expected to extend the detection ranges up to tens of meters and obtain the structure imaging around the borehole. It thus becomes the one of frontier applications of borehole geophysics nowadays. In the recent works, we researched & developed the far distance acoustic imaging tools based on shear wave reflections, as shown in figure 1a. A series of high-power dipole transducers with low frequencies were installed on the probe to generate horizontal vibrations in the borehole and radiate shear waves into the rock formations. During the development of the novel sonic tools, several key technical bottle-necks were broken through, including the real-time transportation of big data, the optimized frequencies for continuous stimulations, hybrid acquisition modes for both monopole and dipole wave components, and processing of weak digital signals, etc. The newly-developed imaging tools were successfully tested in the wellbore over 8000-meter depth, which was embedded in the carbonate rocks with fractures and caves. The reflected shear waves were extracted from the signal arrays. Seismic migration results (in figure 1b) showed that the detection depths could reached 80 meters far away from the borehole. The developments and applications of such novel sonic tools based on shear wave reflections could be expected to push forward the exploration ability of oil/gas reservoirs with small scales outside the borehole in the future.



**Figure 1.** (a) The newly developed single-well imaging tool based on shear wave reflections (b) Imaging results in a carbonate reservoir around the borehole