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Correlation between seismo-acoustic anomalies and sediments gas saturation in the Southern and Central depressions of Lake Baikal.

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Lake Baikal (Russia) represents a unique natural laboratory for multidisciplinary studies of various geological phenomena. In particular, the diffused migration of fluids at numerous locations throughout this deep basin, manifests at the lake floor displaying a variety of degassing sites.
Here we report the geophysical results collected during a dedicated marine expedition conducted in the framework of the international Training Through Research education project “Class@Baikal”. The seismo-acoustic surveys were acquired using a chirp profiler, "sparker" source, and a towed streamer. The data collected from various localities of the lake revealed the presence of acoustic anomalies. We extracted these portions of data to characterize the different types of anomalies that are inferred to be associated with fluid migration and ultimately gas saturation in the sediments.
Indicators of fluid saturation are typically represented by dramatic increase or decrease in the amplitude of the signal, change in the wave pattern, inversion of the reflections, line of correlation deviation due to the velocity effect. The dimensions and dynamic characteristics of the signal were determined for each zone displaying one of these peculiarities. Three types were identified - 1) bright spots 2) sub-vertical zones of loss of correlation and 3) local morphologically positive structures. The "bright spot" (type 1) anomalies are mainly confined to faults, zones of vertical fluid migration, and mud volcanic structures. Such anomalies have high amplitude and sometimes display phase inversion. Subvertical correlation loss zones (type 2) are characterized by low amplitudes relative to the host sediments and are sometimes accompanied by "bright spot" type anomalies. Positive morphology (type 3) structures are also often found together with types 1 and 2.
Using these data, we created a map of the distribution of the types of amplitude anomalies, presumably associated with the gas saturation in the sediment. Next, we compared this map with the localities of known geochemical anomalies that had been determined from the analyses of the sampled sediments. In addition, the areas of seismo-acoustic anomalies were compared with the areas of the BSR (Bottom Simulating Reflector boundary) that are generally interpreted as an indicator for the presence of gas hydrates. Gas saturation in the sediments was verified by bottom sampling several localities that displayed anomalies type 1-3. Although not all the identified anomalies were ground-truthed, the approach proposed herein represents a promising tool for

future sampling campaigns aiming to map the gas composition of various sites of the lake. Conducting accurately positioned coring and measuring the gas content in the sampled sediments, we envisage calibrating these results with the acoustic signature registered in the amplitude anomalies distribution map.