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Near surface geophysics: application of FD-EMI sounding to the study of historical resources

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Sounding with alternating electromagnetic fields has gained a growing attention and a broad usage during the last three decades, including Frequency Domain Electromagnetic Induction (FD-EMI) sounding methods.
A portable electromagnetic sensor (EMS-NEMFIS), developed at IPGG (Siberian Branch of the Russian Academy of Sciences), which is based on such principle, is described in this work. Among the various application areas of such an instrument, focus in this work is given to the near-surface investigation of historical resources.
The description of the device goes through the following steps:
- Architecture of the instrument
- Signal extraction principle
- Tests and characterization

Then, experiences made by using frequency-domain EMI soundings for geophysical applications in archaeology are presented, in order to assess the capability of the approach in such operative framework. In particular, case studies from the South Altay mountains and from Siberia have been selected to be shown in this context.

The burial mounds of Pazyryk culture, dated 2500-3000 B.C., can be found over the wide area of South Altay mountains in Russia, Mongolia and China. This nomadic civilization belongs to the group of Mediterranean cultures. These people stayed in the Altay mountains for quite a short time - just a couple of centuries. Maybe they escaped from Europe due to Alexander Makedonsky wars or to some other unknown reason, and then went back to Europe.
They burial mounds were kept safe because the wooden funeral cameras were buried into permafrost. However, recently, due to global warming, some of those cameras were melt, leading to a decay process. The information about presence of the ice lens inside of the mound is vital for decision to excavate the mound or not. Dozens of such a mounds were explored using NEMFIS during the years 2005 - 2007. Estimation of presence of the ice in some of them helped to find few good conserved burial cameras and safe a lot of resources for archaeologists.
Site # 15 of Cicah settlement is located in the Novosibirsk area. Cicah settlement is the large monument of Skyth culture. The general magnetic map of the settlement was made by Dr. Fassbinder and Dr. Becker. Then, many interesting spots were studied by NEMFIS to get more detailed information. Site # 15 was explored prior to excavation. The good correlation between NEMFIS signal distribution and the site inner structure can be seen.
The area of Vengerovo town, located about 400 km West of Novosibirsk, was populated by various nomadic civilizations in the period between 3000-1000 B.C. The remains of such a nomadic life can be found all over the western Siberia as mounds, buried settlements, burial and ceremonial objects etc. Almost all of them were robbed in medieval ages and especially in XVIII century by expeditions launched by Peter the Great, Russian Emperor, to enrich his collection of ancient gold. As an example, Pogorelka is one of the typical mound presented at the area. Investigation of selected places in such areas is also discussed in this work.