Cost-effective onshore geophysical acquisition through operational efficiency and fit-for-purpose deliverables

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1. ABSTRACT

The introduction of cable-free recording systems and high-productivity vibroseis techniques have revolutionized onshore land seismic operations in difficult terrain, increasing efficiency and trace density to provide better seismic deliverables in a cost-effective way with smaller, more agile crews. Lessons learned can be applied to exploration programs associated with the UK onshore 14th round.

Operations with cable-free recording systems offer a high degree of flexibility to deal with physical restrictions in the survey area such as infrastructure, rivers and woods with a minimal environmental footprint. Operational efficiency is also enhanced by high-productivity acquisition techniques such as single vibrator acquisition, aggressive slip-sweep methods and full blended acquisition solutions. Advanced broadband and proprietary “low-dwell” and anti-distortion sweep coding technology allows the highest quality seismic deliverables. We provide an overview of the technology and techniques which are setting a new standard in cost-effective data quality.

2. INTRODUCTION

Since the last big step in land seismic operational efficiency from the introduction of vibroseis, some improvements occurred with digital recorders, vibroseis source control, and increasing channel count in parallel with increased source productivity, in open desert environments.

In the UK and Europe, attempts were also made to increase the productivity and channel count but with a limited amount of equipment and personnel compared to Middle East “mega crews”. Unable to achieve the same efficiencies of scale that were enjoyed in the Middle East, acquisition costs were not being driven down to the same level. Then, a revolution came through wireless recording technology initially used onshore in North America within the shale gas plays. This technology has spread across Europe in the last decade and has been a dramatic game-changer, with the development of a full range of wireless acquisition systems. In the meantime, the lessons learned in Middle East also started to be adapted to Europe, first in 3D with slip sweep, single source, and single sensor acquisitions and now blending techniques. Lastly, land broadband solutions came into maturity with better vibroseis sweep algorithm control allowing reliable broadband low-dwell sweep generation.

3. WIRELESS RECORDING REVOLUTION

In its first steps, wireless acquisition and recording technology needed heavy equipment and external batteries and was not providing any QC during recording and even less data harvesting capacity. Its use was driven first by permitting and public relations issues in the shale gas plays. Two directions were taken by the equipment manufacturers.

The first technological direction was betting on “blind shooting”, making the equipment low power consumption and allowing it to reach nearly a month of recording duration. But as a consequence, data is at risk in the field whether from malfunction, equipment theft or damage. The second way of development was looking to maintain real-time recording in the central recording unit (dog house) through an active wireless telemetry link, so that they behaved more like cabled systems. Even if

claimed, there is still no evidence of real-time wireless acquisition systems being able to guarantee 100% real-time recording on a commercial field operation due to technology limitations.

A pragmatic compromise and a middle path between these two, was chosen by Sercel with the Unite® *EX* system [1]. It allows the harvesting of QC attribute and on-request real-time data harvesting solutions on a limited number of channels. This allows data assurance and regular data gathering, reducing the risk of data loss without degrading battery life and deployment duration. With wireless systems, the daily acquisition cycle in the field is streamlined and the shooting duration is increased by at least 2 hours per day as there is no need for line forming every morning and disconnection in the evening. In addition it removes the down time associated with line cuts during the survey, further improving productivity. Typically, wireless spreads can achieve higher coverage than cabled systems, providing better fold and more regular offset/azimuth sampling.

4. SOURCE PRODUCTIVITY IMPROVEMENTS

Vibroseis is well established as the preferred seismic source. It allows higher survey productivity than explosives, especially with the introduction of Slip Sweep acquisition. Vibroseis productivity has continued to increase over the last decade with innovations including HPVA, “aggressive slip-sweep” with reduced slip times and single vibrator acquisition. Most recently we have seen the adoption of simultaneous shooting schemes like DSSS and fully blended simultaneous sources. In terms of applicability to Europe, aggressive slip-sweep and single-vibrator schemes can easily be implemented for 2D and 3D surveys. Recently, agile crews experienced in optimizing equipment distribution in the field have deployed customized designs, which fit both complex terrain and challenging geology, and thus have proven the application of versatile and lighter acquisition systems from smaller arrays to single sensor, single vibrator source, single sweep for 3D surveys, providing a significant productivity and trace density increase [2].

5. BROADBAND LIKE MARINE

Historically land seismic data has typically been band limited with poor image quality due to a range of issues linked to the near surface and multiples. With the introduction of broadband vibroseis sweeps, and now anti-distortion broadband sweeps, the ability to recover a larger bandwidth from land seismic is possible. With complementary advances in seismic processing it is possible to achieve up to 6 octaves of bandwidth with resulting images having the appearance of the new generation of marine broadband seismic.

6. CONCLUSION

Latest developments in wireless recording technologies and high-productivity acquisition solutions, coupled with improved versatility in the equipment distribution in the field, allow us to move from heavy and sparse to lighter and denser acquisitions, which enables cost-effective implementation of surveys in complex environments. Moreover, combining the improved acquisition productivity techniques with the latest anti-distortion broadband sweep technology allows onshore seismic to enter the era of broadband seismic without impacting field productivity.

7. REFERENCES

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