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Advanced 3D Land Internal Multiple Modeling and Subtraction, a wide azimuth Oman case study

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SUMMARY

Internal multiple attenuation presents a major problem to both the geologist and the geophysicist. For the first the amount of noise can often be such that accurate interpretation of the primary seismic wavefield is impossible making seismic data unusable. For the second, internal multiples are hard to distinguish in the total wavefiled, and the problem is more difficult to deal with than with surface related multiple. Internal multiples have a dispersed character that creates a curtain of noise often stronger than primaries where move out discrimination or deconvolution techniques fail.

If strong reflectors generating multiples are present and identified in the subsurface, re-datuming the wavefield of all shot points and receivers to the generators is possible, thus making each reflector a new buried surface from which the SRME process can be engaged. However in the Middle East it is not always possible to identify clearly the multiple generators given the large number of possible candidates.

In this Oman land case study we propose a methodology using a wave equation based internal multiples modeling technique. The methodology consists in modeling the multiple wavefield for a variety of multiples generators (for any multiple order) to be subtracted from the total wavefield afterward. More precisely, in windows around generators, allowing all multiple ray paths for all orders and all periodicities to be generated and subtracted from the total wavefield and this without precise identification of the multiple generators. The windows used in the modeling are selected around the identified or suspected multiple generators on the reflectivity series.

The generated multiple wavefields are then simultaneously subtracted from the total wavefield using a least square adaptive subtraction technique in the common offset vector (COV) domain. For wide azimuth surveys Subtraction in COV domain allows flexibility for testing, production and quality control, as well as optimum efficiency, as each COV planes is subtracted from its multiple content as if it was a stacked volume.

The results on a complex 3D wide azimuth land dataset survey are extremely encouraging. The method is fully 3D, accurate, efficient yet primary wavefield preserving and integrates well in the seismic processing workflow of both modern and vintage (narrow azimuth) seismic surveys.