Conclusions The attenuation of multiples reflections in complex subsurface areas is best done in the image space. This domain is smaller, regular, and the primaries are guaranteed to map to well known regions: near zero subsurface offsets in SODCIGs and to flat, well focused events in ADCIGs. Multiples have predictable (to first order) residual moveout in this domains and we can separate them from the primaries in the Radon domain.

In Chapter **??** I showed the approach in detail for the 2D case. I presented the equations for the residual moveout of the specular water-bottom multiples in SODCIGs and ADCIGs and use them to design a new Radon kernel that improves the focusing of the multiples in that domain. I attenuated specular and diffracted multiples with synthetic and real data using an apex-shifted version of the Radon transform.

Before subtracting the estimated multiples from the data to estimate the primaries, we need to make sure that differences in phase and amplitude between the data and the multiple model are taken into account. In Chapter **??** I presented a new approach to simultaneously match estimates of multiples and primaries to the data. I posed the adaptive matching as a least-squares problem to estimate non-stationary filters for both the primaries and the multiples. The process is iterative with the estimates of the primaries and multiples being updated every time the least-squares solution is found. I showed that we can get good results with relatively few iterations and illustrated the method with synthetic and real data.

I extended the ideas of Chapter **??** to 3D in Chapter **??** and used a synthetic 3D prestack dataset to illustrate the mapping of both primaries and multiples to SODCIGs and ADCIGs. In particular I showed that primaries and multiples behave differently in ADCIGs not only as a function of aperture angle but also as function of azimuth. While the azimuth resolution of primaries increases with the increase of aperture angle, the multiples never show any azimuth resolution at all. This is a consequence of the crossline dip that prevents them from traveling in a single plane even in constant velocity.

In Chapter **??** I illustrate the mapping of subsalt primaries and multiples from a real 3D dataset from the Gulf of Mexico. The five-dimensional prestack image cubes of SODCIGs or ADCIGs are challenging to visualize on paper but I showed that, similar to the results in 2D and with the 3D synthetic example, the multiples map away from zero subsurface offsets in SODCIGs and with non-flat residual moveout as a function of aperture angle in ADCIGs. SODCIGs are shown to be a simple but useful tool in identifying multiples and telling them apart from primaries. I also showed that, despite the relatively narrow range of aperture angles that illuminate both the primaries and the multiples, enough difference in residual moveout exists between them to make it possible to attenuate the multiples in the Radon domain.

For the sake of computer time, I applied the Radon filtering on azimuth-stacked ADCIGs. The final results of the multiple attenuation, presented in Chapter **??**, show that the most significant multiples were indeed attenuated. I showed that on individual azimuth-stacked ADCIGs as well as inline and crossline sections. Most of the multiple energy was attenuated but some multiple energy remained and some weak energy from the primaries still mapped into the multiples.

I believe that there is ample opportunity to refine the basic procedure I developed in this thesis and I look forward to seeing improvements from other researchers. Attenuation of multiples is still a germane problem in our industry.