CHAPTER 3

Results

3.1 The migration impulse response

The migration impulse response with constant velocity 2000m/s of Gazdag migration in Cartesian and log-polar coordinate systems and 15-degree Finite-difference migration in Cartesian and log-polar coordinate systems were shown in Figure 3.2, Figure 3.3, Figure 3.4 and Figure 3.5 respectively. The migration impulse response of Gazdag and 15-degree Finite-difference in log-polar coordinate systems can handle high angle energy. Those of them do not have the angular limitation as we see in figure below.

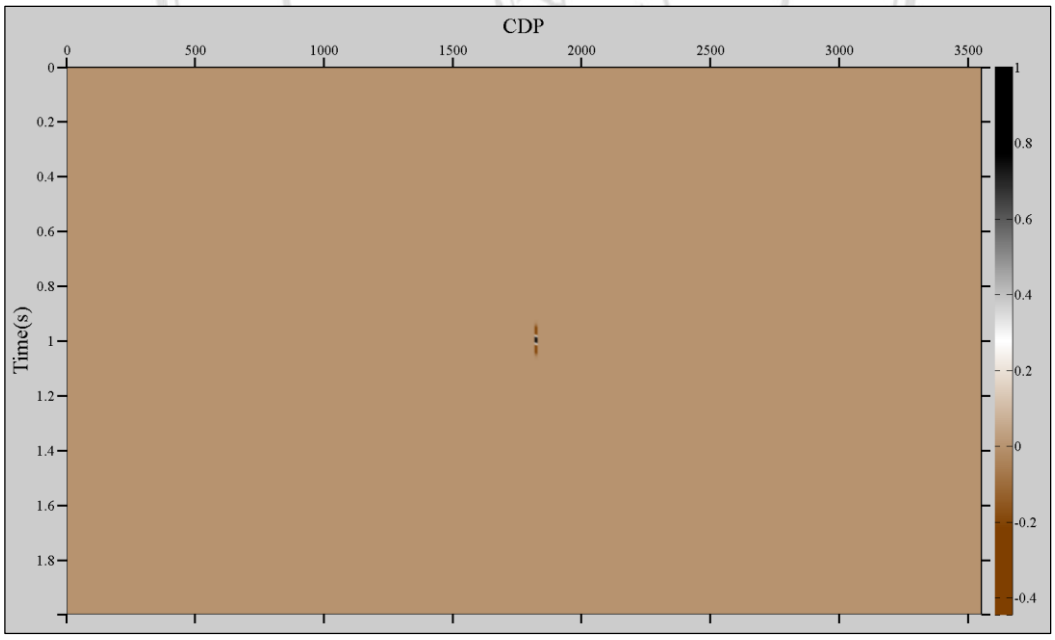

Figure 3.1 Wavelet

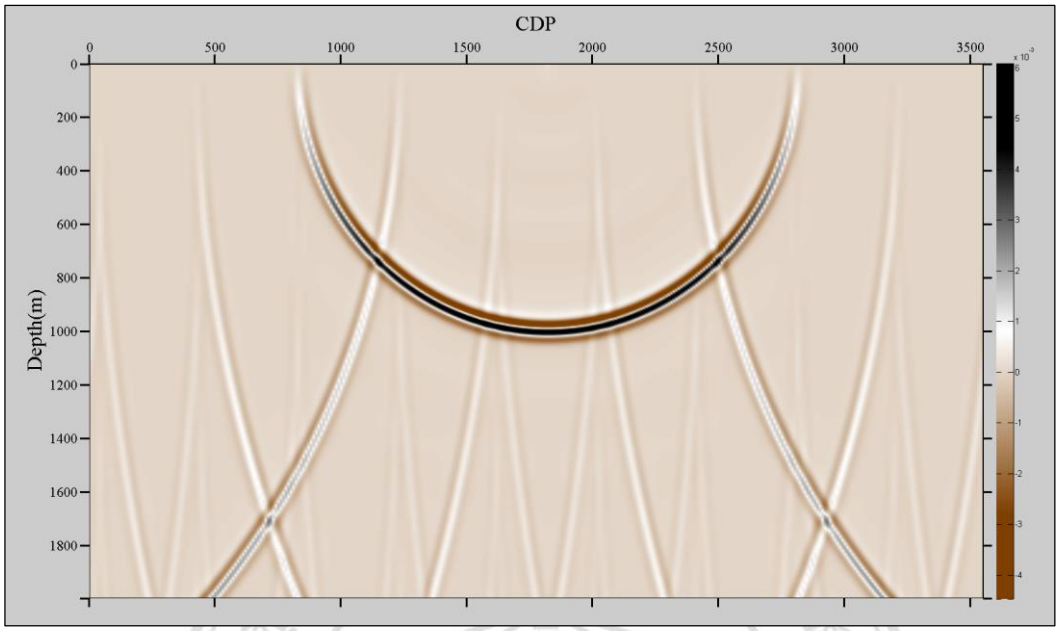

Figure 3.2 Gazdag migration impulse response in Cartesian coordinate system with constant velocity 2000m/s.

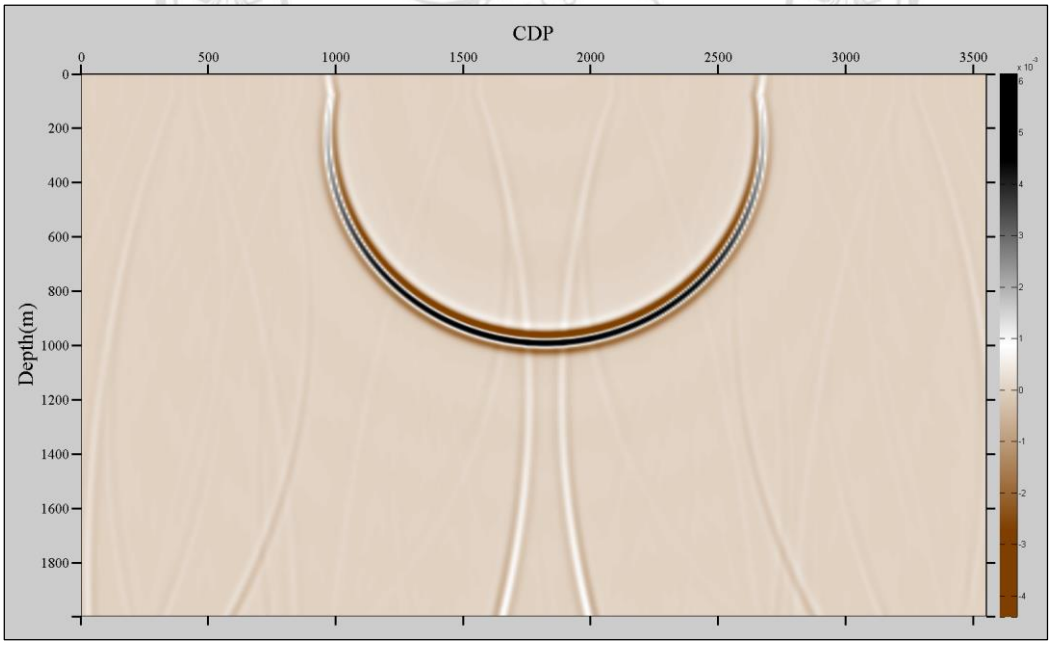

Figure 3.3 Gazdag migration impulse response in log-polar coordinate system with constant velocity 2000m/s.

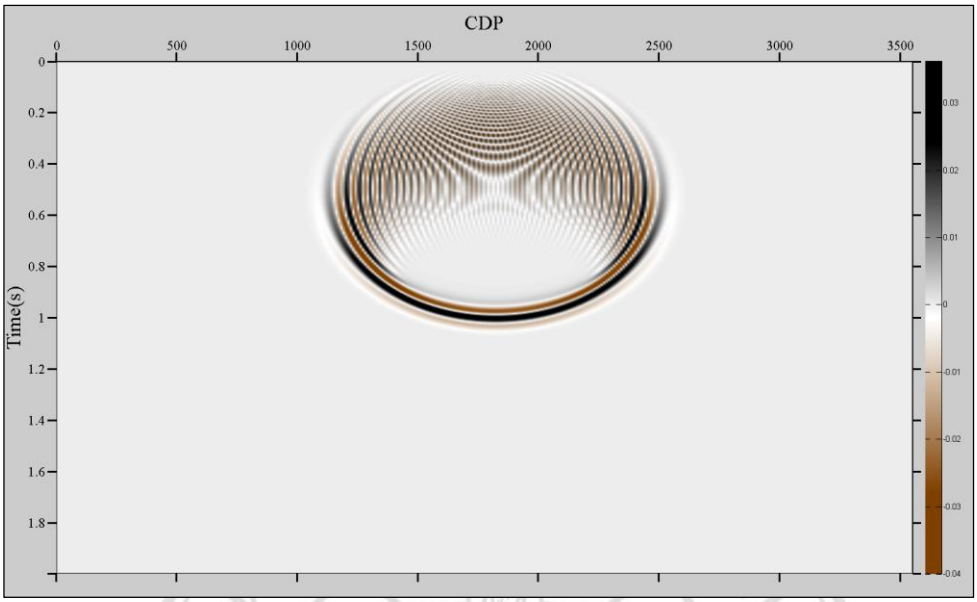

Figure 3.4 15-degree Finite-difference migration impulse response in Cartesian coordinate system with constant velocity 2000m/s.

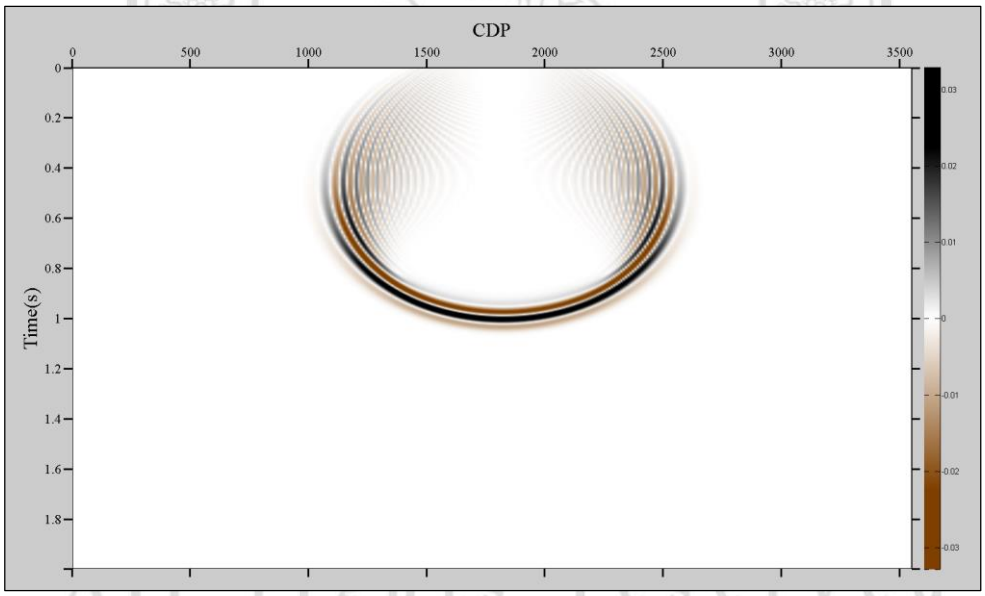

Figure 3.5 15-degree Finite-difference migration impulse response in log-polar coordinate systems with constant velocity 2000m/s.

The migration impulse response with Marmousi velocity (Figure 3.6) of Gazdag migration in Cartesian and log-polar coordinate systems and 15-degree Finite-difference migration in Cartesian and log-polar coordinate systems with were shown in Figure 3.7, Figure 3.8, Figure 3.9 and Figure 3.10 respectively. The results show the shape of

migration impulse response are not symmetry due to complex velocity but the migration impulse response in log-polar present high angle energy go to 90 degrees.

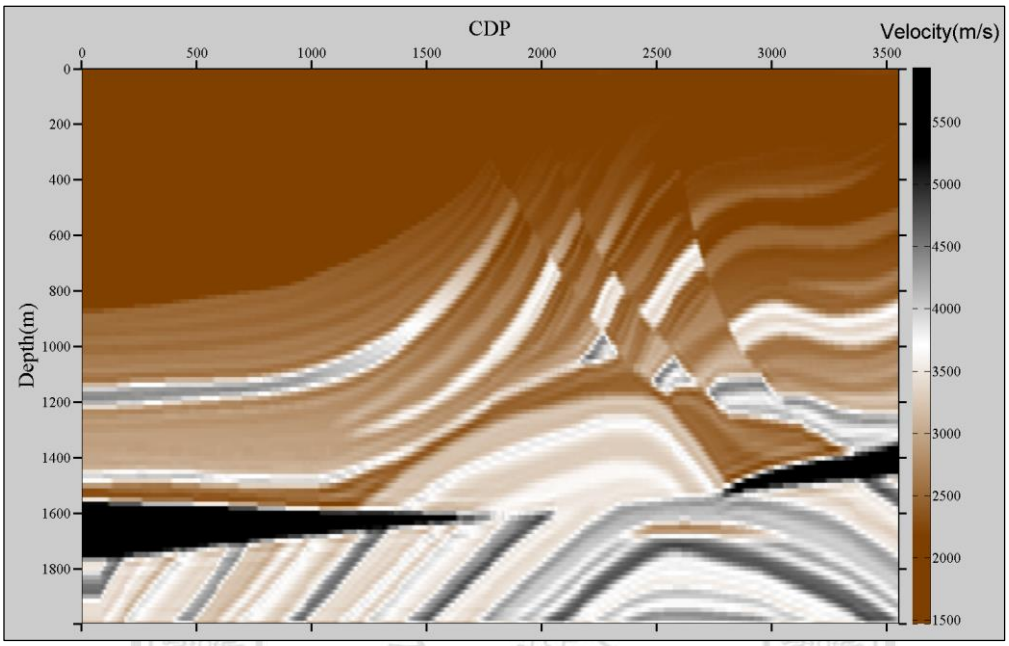

Figure 3.6 Marmousi velocity.

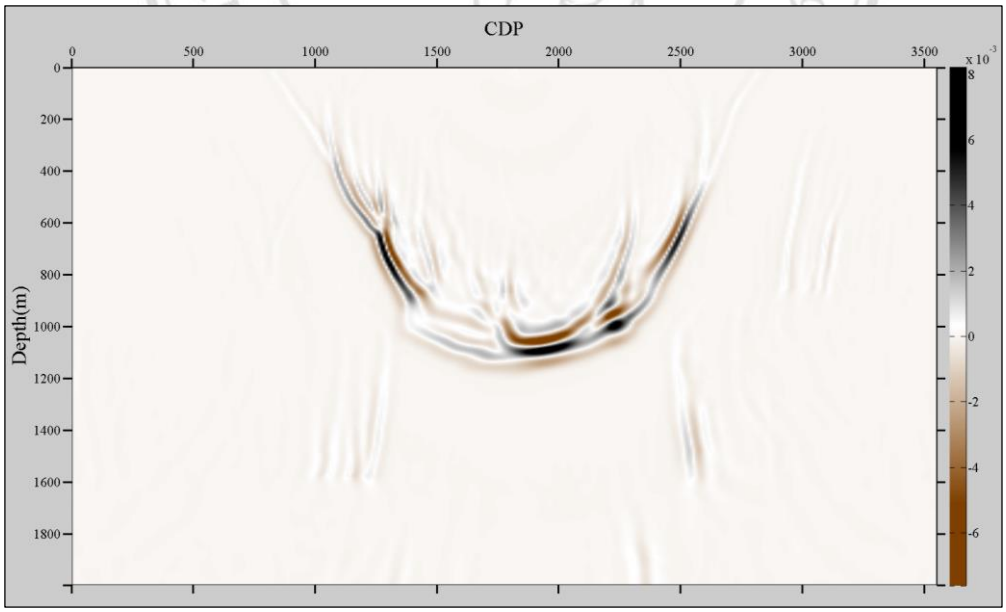

Figure 3.7 Gazdag migration impulse response in Cartesian coordinate system with Marmousi velocity.

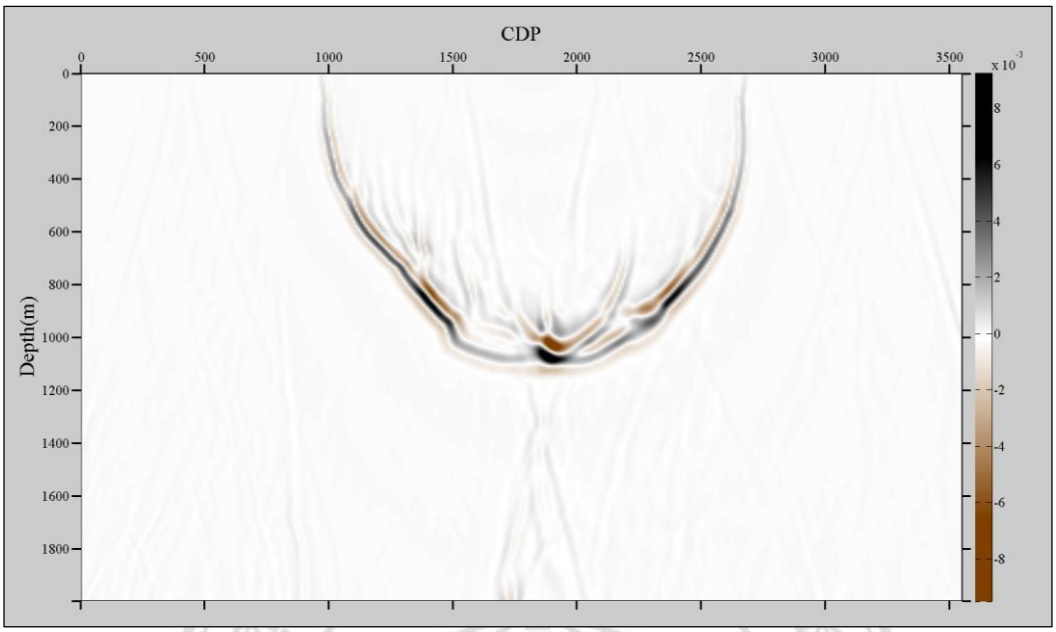

Figure 3.8 Gazdag migration impulse response in log-polar coordinate system with Marmousi velocity.

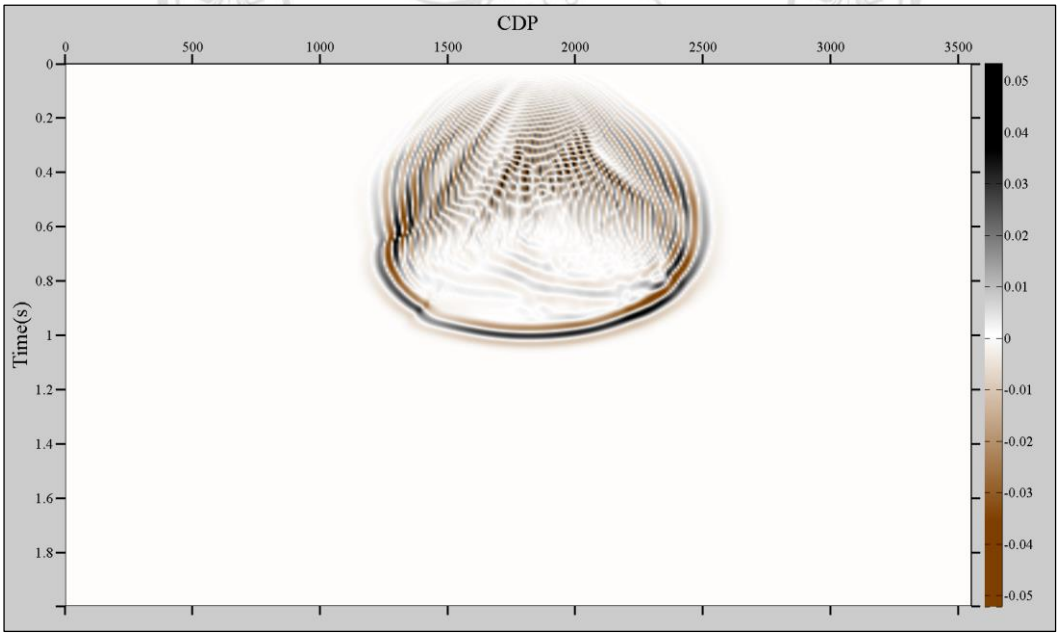

Figure 3.9 15-degree Finite-difference migration impulse response in Cartesian coordinate system with Marmousi velocity.

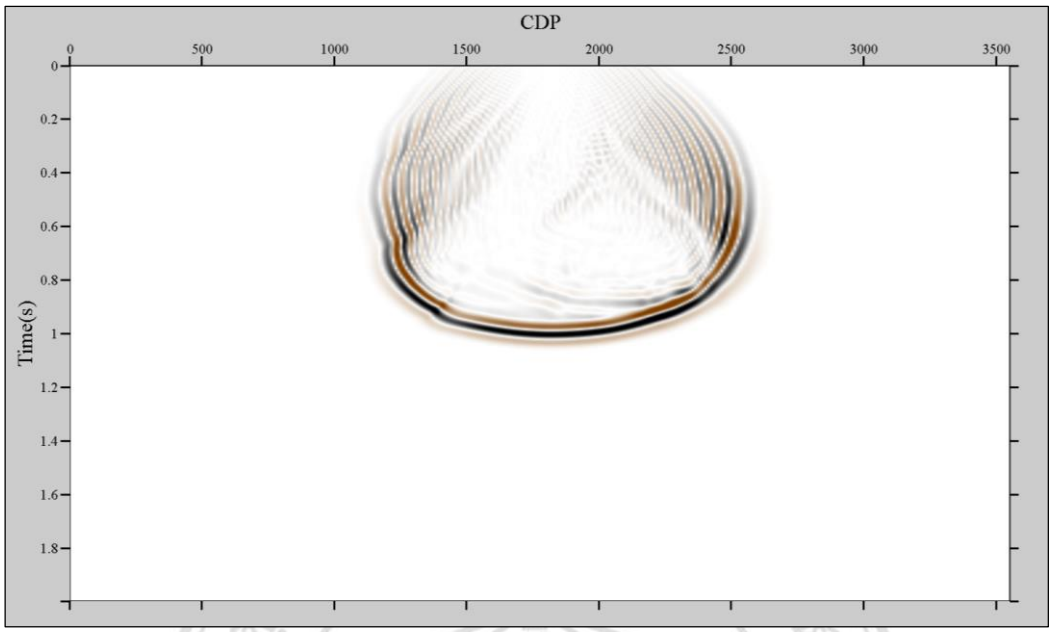

Figure 3.10 15-degree Finite-difference migration impulse response in log-polar coordinate systems with Marmousi velocity.

3.2 The synthetic data set

The synthetic velocity data and unmigrated synthetic data were shown in Figure 3.11 and Figure 3.12. In Figure 3.13 shows the unmigrated data after interpolated to log-polar coordinate system at one origin located on the surface. The migration result of Figure 3.13 by Gazdag migration and 15-degree Finite-difference in log-polar coordinate systems were shown in Figure 3.14 and Figure 3.15. Finally, we moved the origin along the profile. The Gazdag migrated section in Cartesian and log-polar coordinate systems of synthetic seismic data shows in Figure 3.16 and Figure 3.17. The syncline was imaged in log-polar coordinate clearly than Cartesian which is image of steeply dipping reflector. The 15-degree Finite-difference in both coordinate systems cannot image syncline correctly due to 15-degree equation as we can see in Figure 3.18 and Figure 3.19.

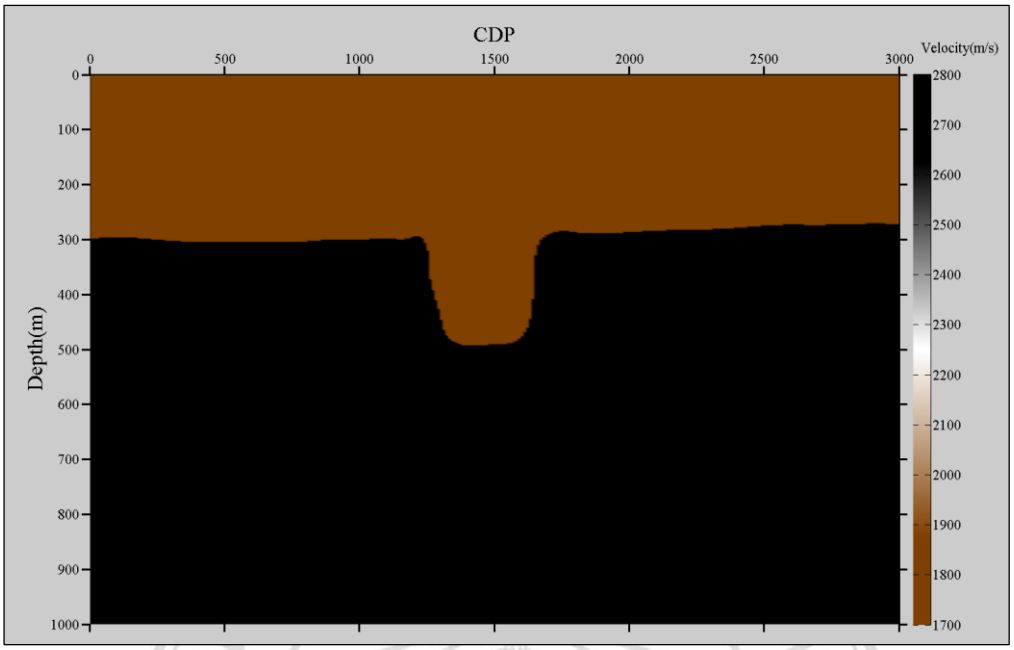

Figure 3.11 The synthetic velocity data

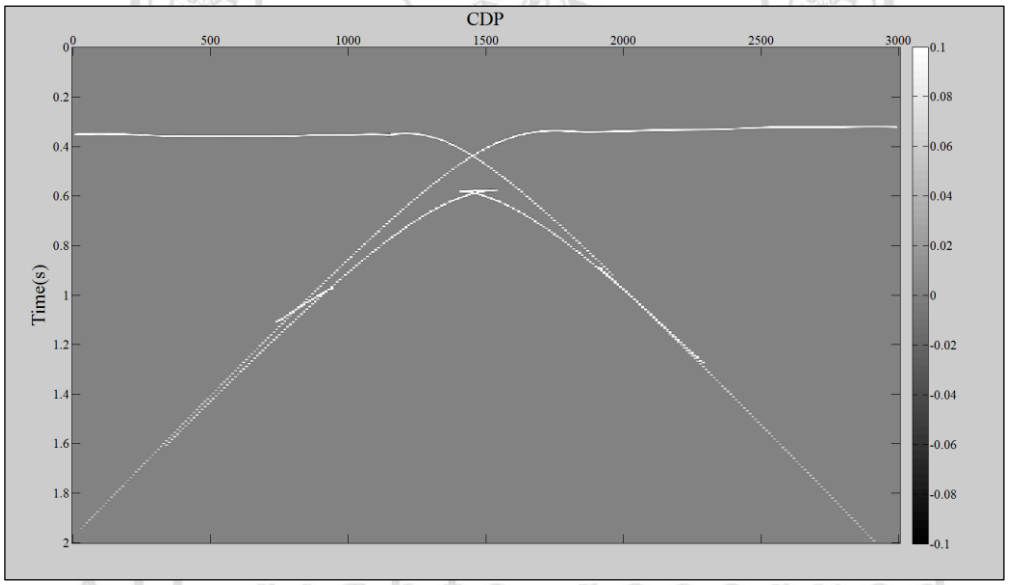

Figure 3.12 Unmigrated synthetic data

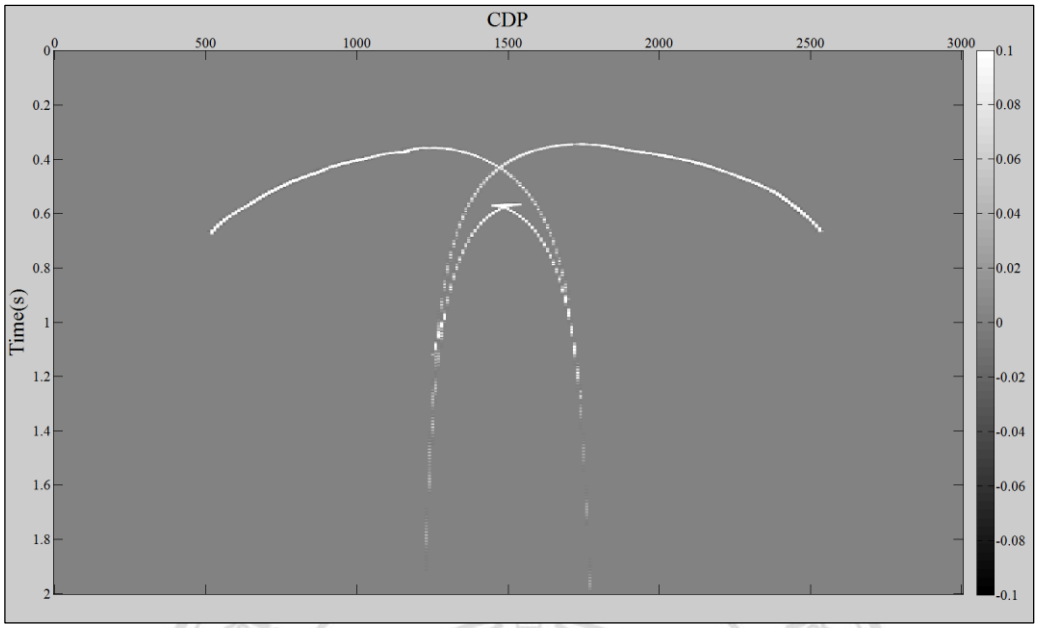

Figure 3.13 After interpolated to log-polar coordinate system.

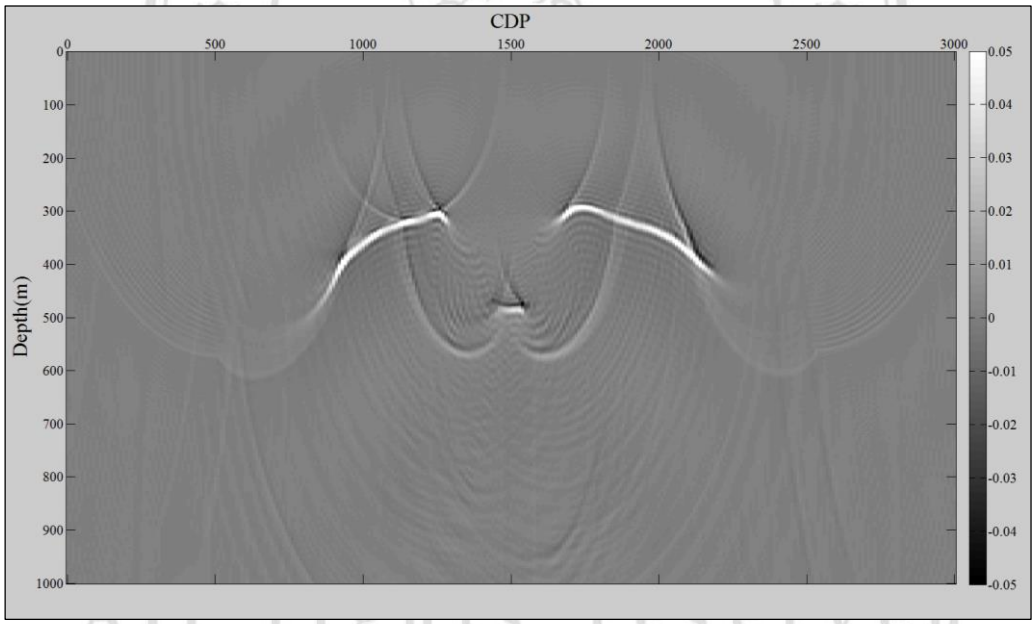

Figure 3.14 The data in log-polar coordinate system after migration with Gazdag migration method.

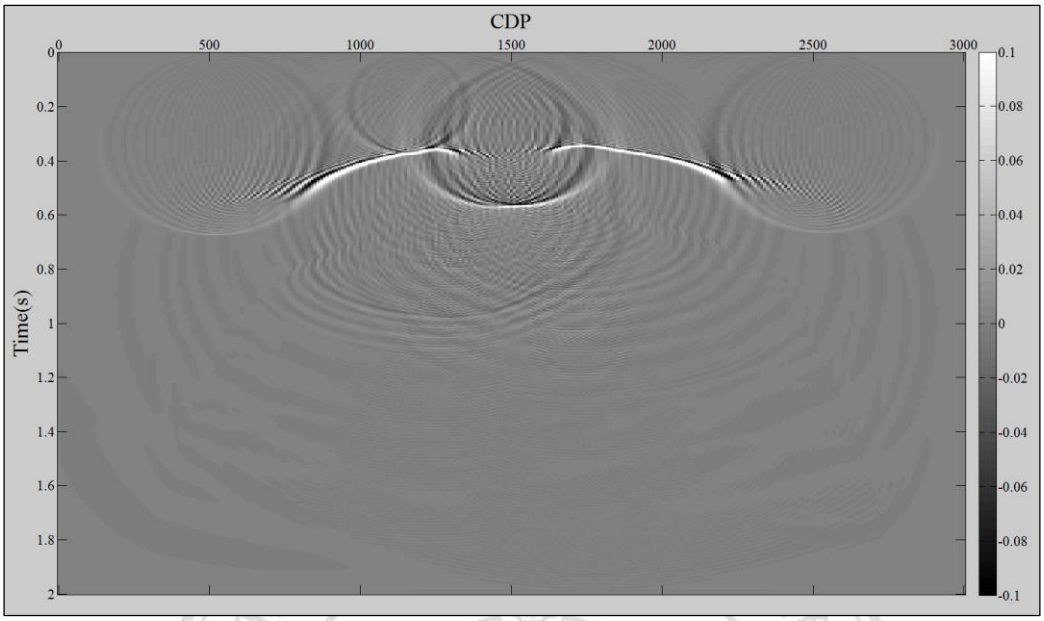

Figure 3.15 The data in log-polar coordinate system after migration with 15-degree Finite-difference migration method.

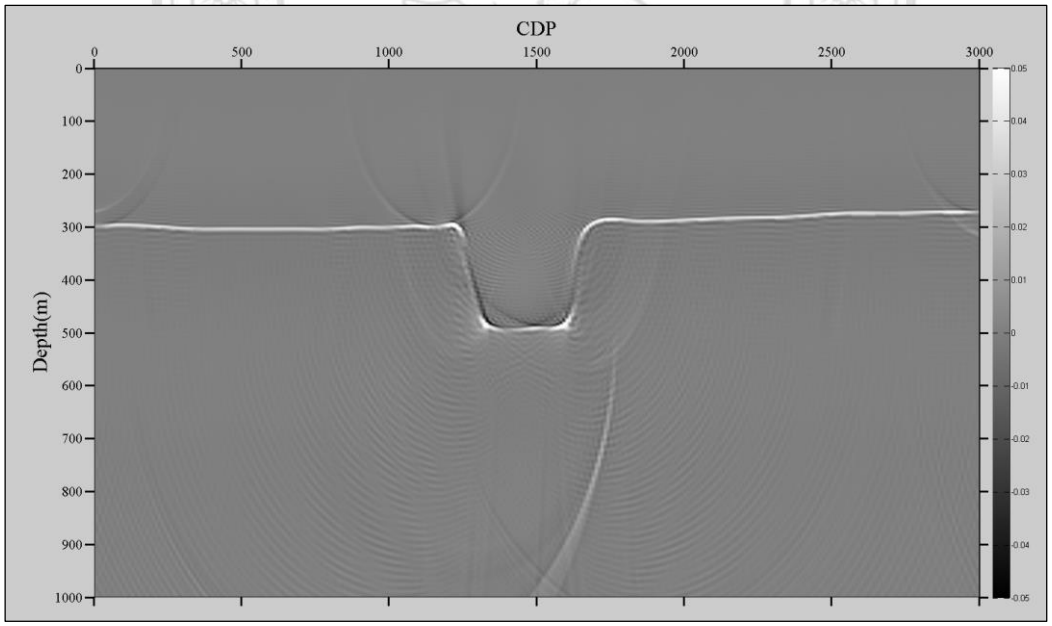

Figure 3.16 Gazdag migration result in Cartesian coordinate system of syncline synthetic data

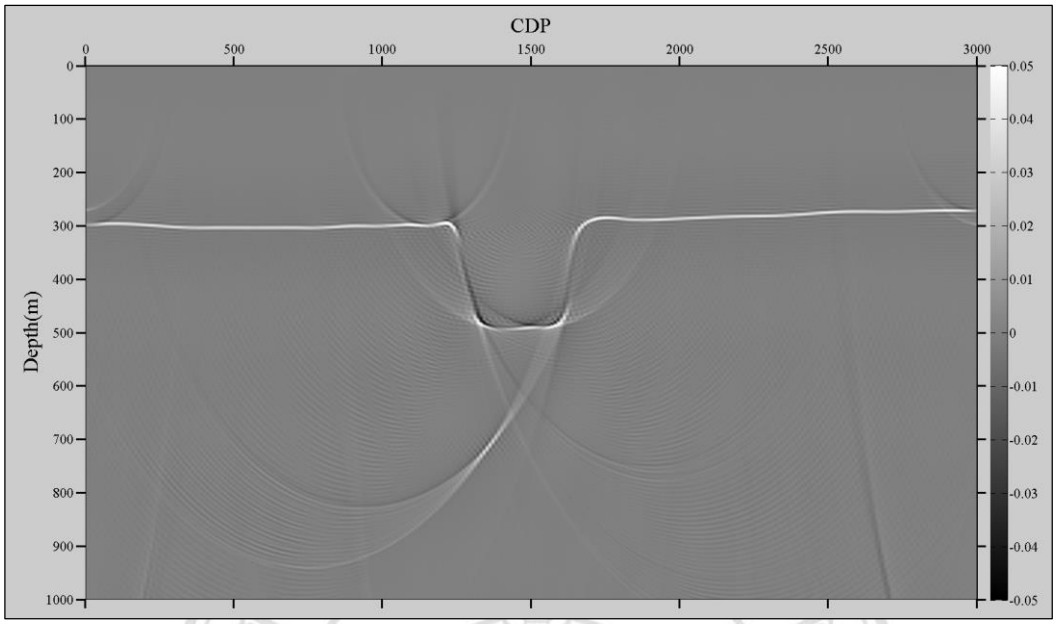

Figure 3.17 Gazdag migration result in log-polar coordinate system of syncline synthetic data

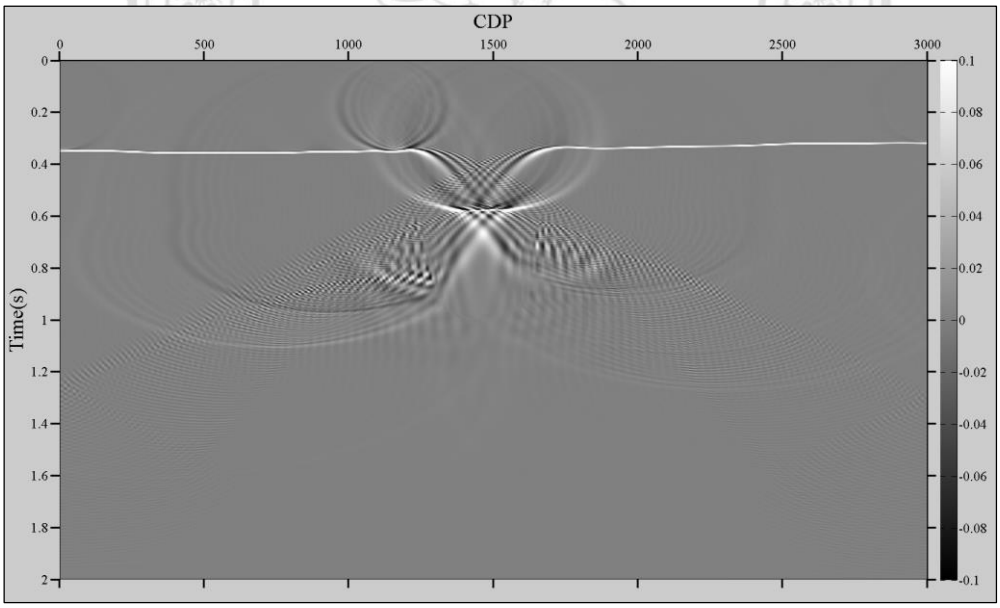

Figure 3.18 15-degree Finite-difference migration result in Cartesian coordinate system of syncline synthetic data.

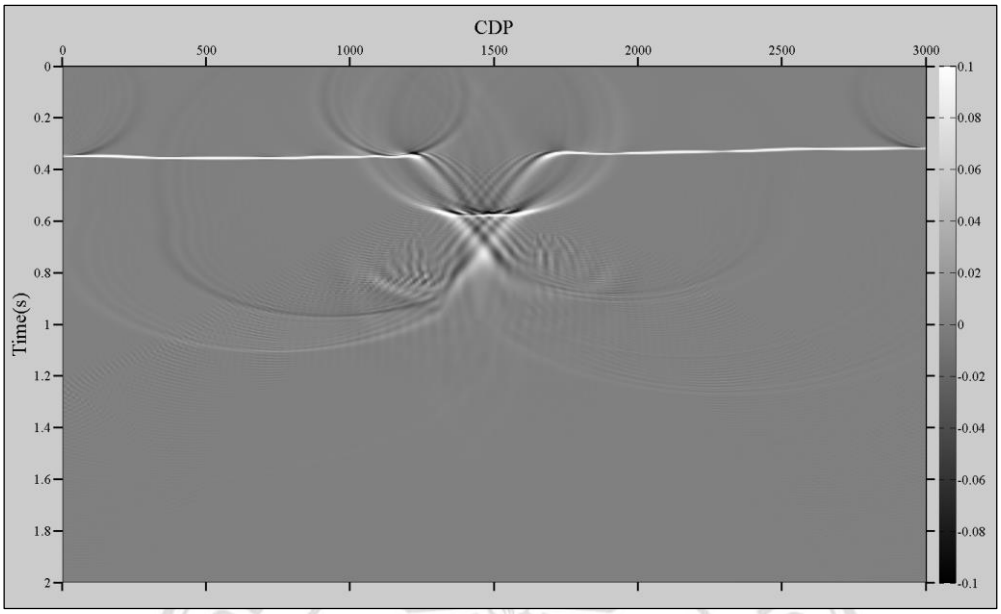

Figure 3.19 15-degree Finite-difference migration result in log-polar coordinate system of syncline synthetic data.

3.3 Post-stack unmigrated section

The seismic line results of the 2D post-stack unmigrated seismic sections of the Shelikof Strait and Norton Sound areas are shown for WSS140 (Figure 3.20), WSS160 (Figure 3.21) of Shelikof Strait and WNS324 (Figure 3.22), WNS325 (Figure 3.23) of Norton Sound include geological structures such as anticline, syncline, fault and intrusion. Migration in the Cartesian and log-polar coordinate systems was conducted using the Gazdag and 15-degree Finite-difference methods. The results for each method were then compared in both coordinate systems. The migrated seismic sections showed the results of 15-degree Finite-difference methods between Cartesian and log-polar coordinate systems are shown little difference between two coordinate systems.

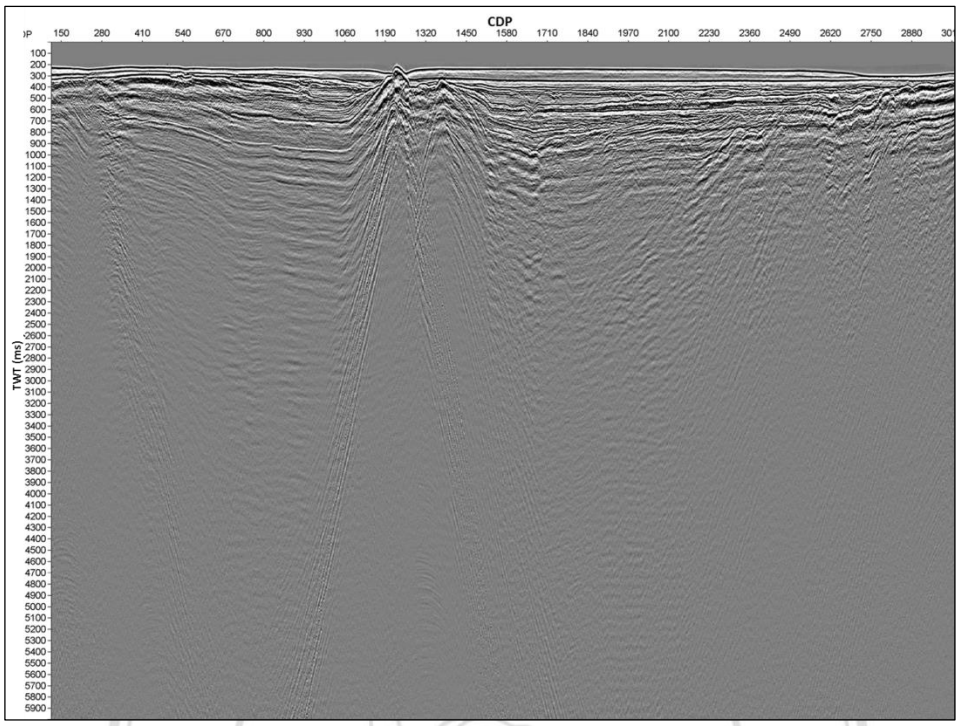

Figure 3.20 Post-stack unmigrated section of WSS140-Shelikof Strait, Alaska.

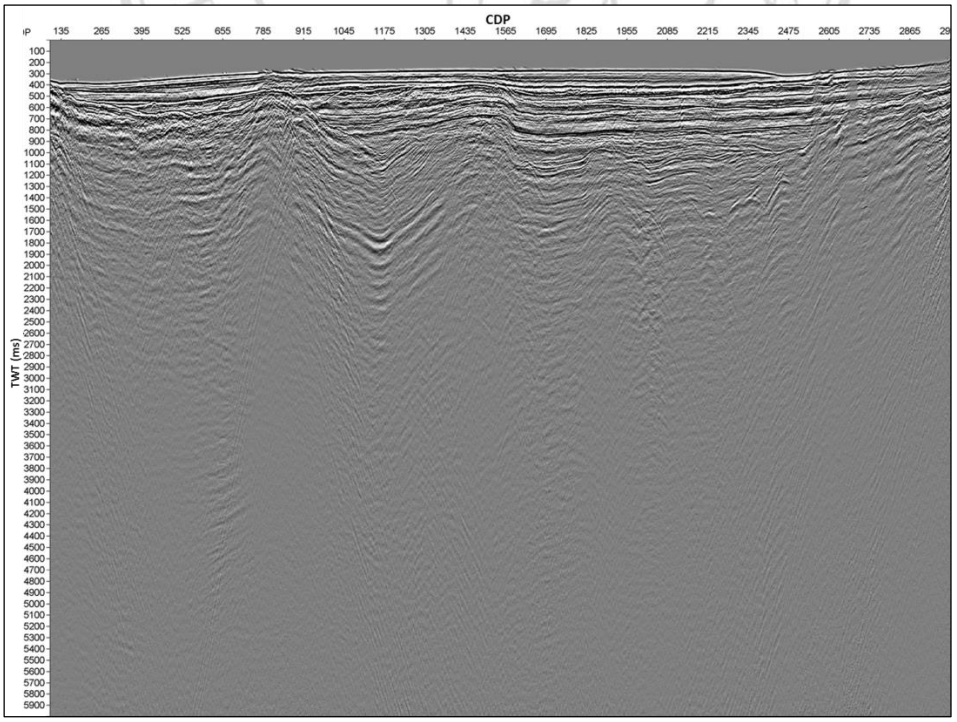

Figure 3.21 Post-stack unmigrated section of WSS160-Shelikof Strait, Alaska.

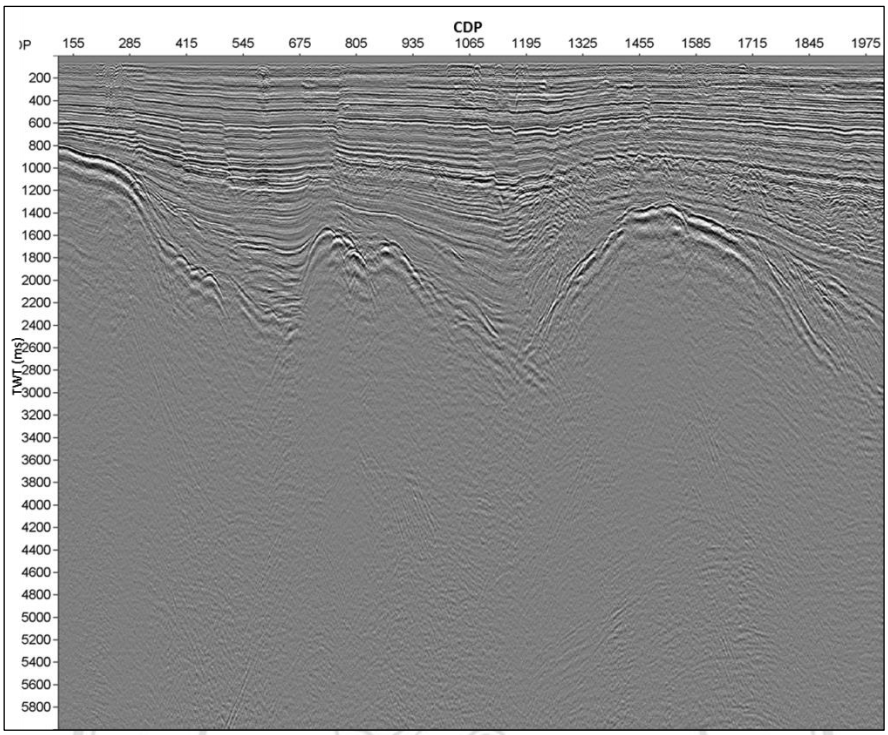

Figure 3.22. Post-stack unmigrated section of WNS324-Norton Sound, Alaska.

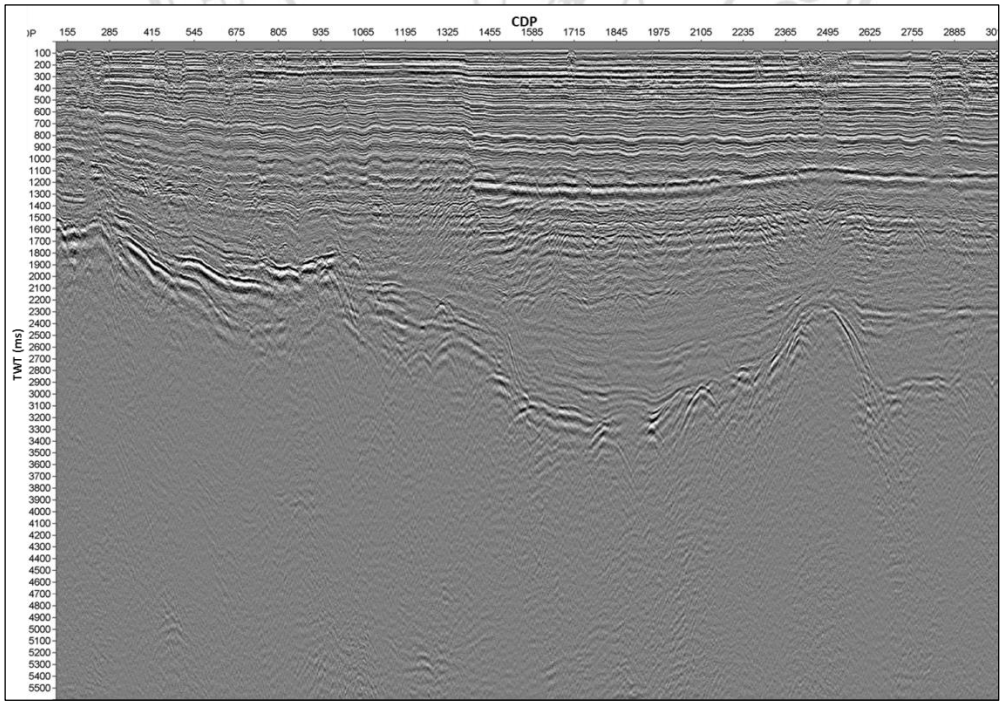

Figure 3.23 Post-stack unmigrated section of WNS325-Norton Sound, Alaska.

3.4 Post-stack migration result of WSS140-Shelikof, Alaska

The Gazdag in Cartesian and 15-degree Finite-difference migrated sections of WSS140-Shelikof Strait in Cartesian and log-polar coordinate systems are shown in Figure 3.24, Figure 3.25 and Figure 3.26 respectively. The estimated instantaneous frequency of those sections in both coordinate systems, shown in Figure 3.28a, Figure 3.28b and Figure 3.28c, illustrate that the migrated section in log-polar coordinates has a little bit lower frequency than the migrated section in Cartesian coordinate system but higher than Gazdag migration result in Cartesian coordinate. Figure 3.27a, Figure 3.27b and Figure 3.27c show the shallow part of the migrated section in Gazdag migration in log-polar and 15-degree Finite-difference in both coordinate systems. In 15-degree Finite-difference, the basin, thin layer and dipping reflectors were imaged in both coordinate systems but thin layer was imaged clearly by Gazdag migration in log-polar coordinates.

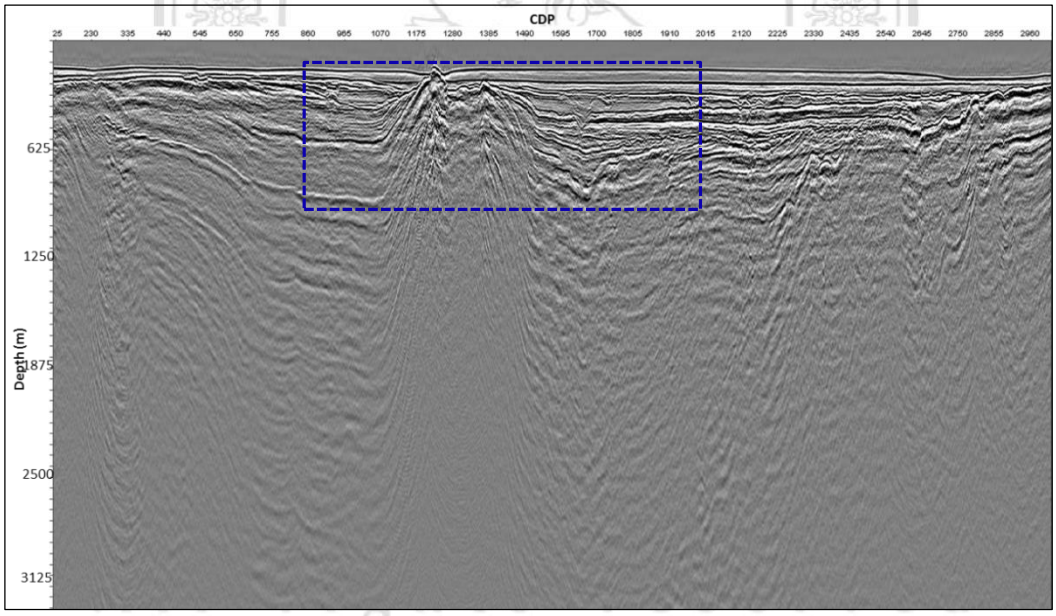

Figure 3.24 WSS140-Shelikof Strait, Gazdag migrated section in Cartesian coordinate system

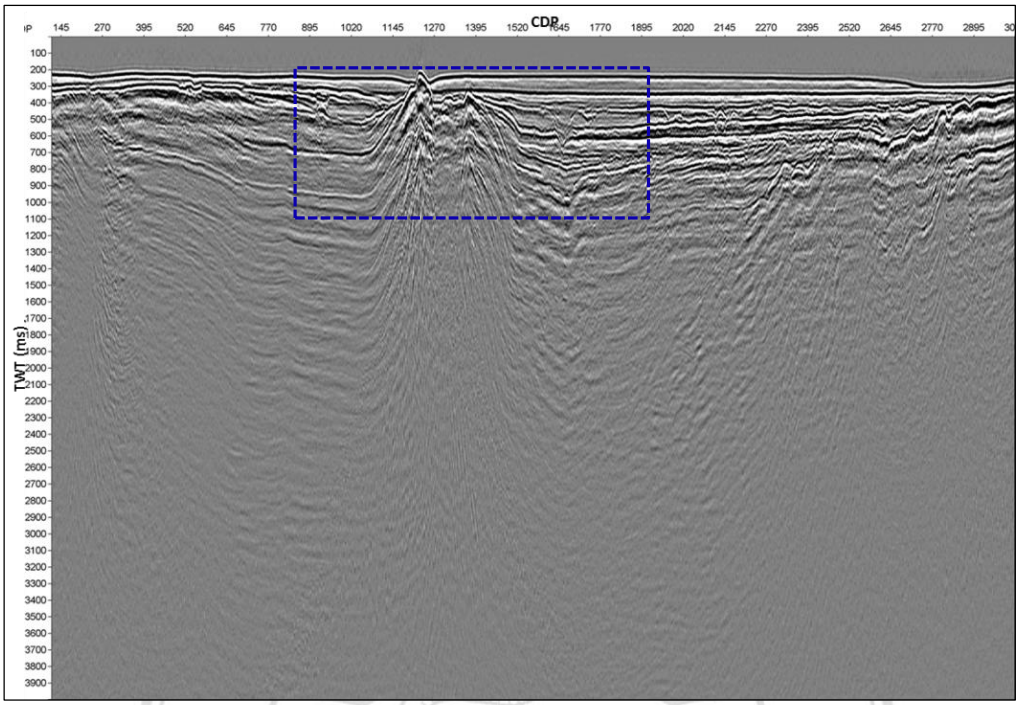

Figure 3.25 WSS140-Shelikof Strait, 15-degree Finite-difference migrated section in Cartesian coordinate system.

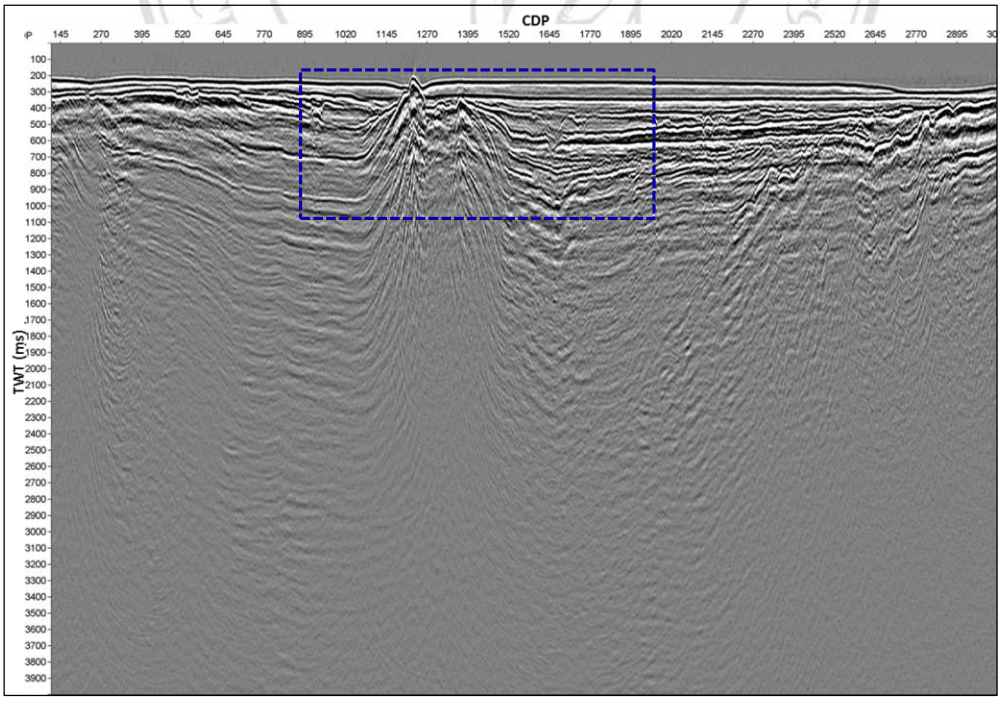

Figure 3.26 WSS140-Shelikof Strait, 15-degree Finite-difference migrated section in log-polar coordinate system.

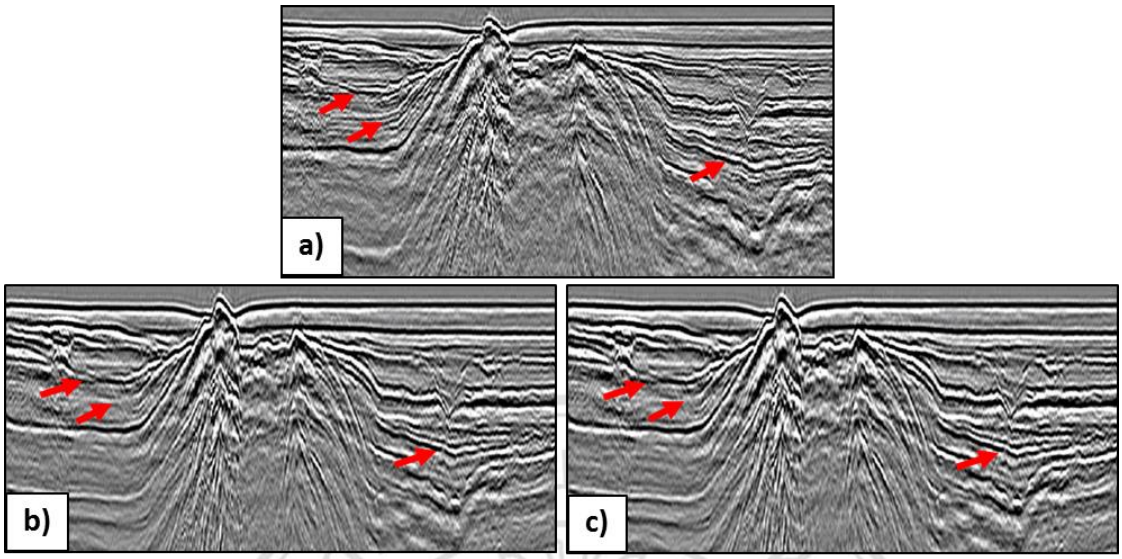

Figure 3.27 Shallow part of WSS140-Shelikof Strait: a) Gazdag migrated section in Cartesian b) 15-degree Finite-difference migrated section in Cartesian c) 15-degree Finite-difference migrated section in log-polar coordinate system.

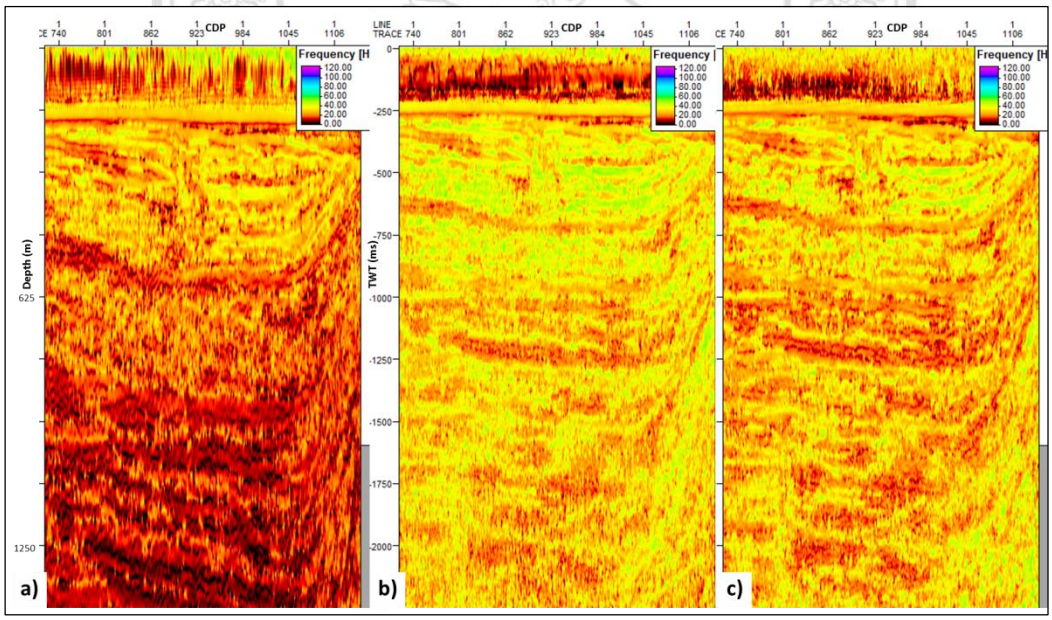

Figure 3.28 Instantaneous frequency of WSS140-Shelikof Strait: a) Gazdag migrated section in Cartesian b) 15-degree Finite-difference migrated section in Cartesian c) 15-degree Finite-difference migrated section in log-polar coordinate system.

3.5 Post-stack migration result of WSS160-Shelikof, Alaska

In Figure 3.29, Figure 3.30and Figure 3.31, Gazdag migrated and 15-degree Finite-difference migrated sections of WSS160-Shelikof Strait in Cartesian and log-polar coordinate systems are shown, respectively. Figure 3.33a, Figure 3.33b and Figure 3.33c present the estimated instantaneous frequency in both coordinate systems. In the result of 15-degree Finite-difference, log-polar coordinate system shows slightly lower frequency than Cartesian coordinate. Comparing results shows that imaged sections in both coordinate systems are very similar overall but the result of Gazdag migration in Cartesian coordinate was highlighted by red arrow and yellow square in Figure 3.32a shows high continuity of the channel more clear than the result of 15-degree Finite-difference in both coordinate systems (Figure 3.32b and Figure 3.32c).

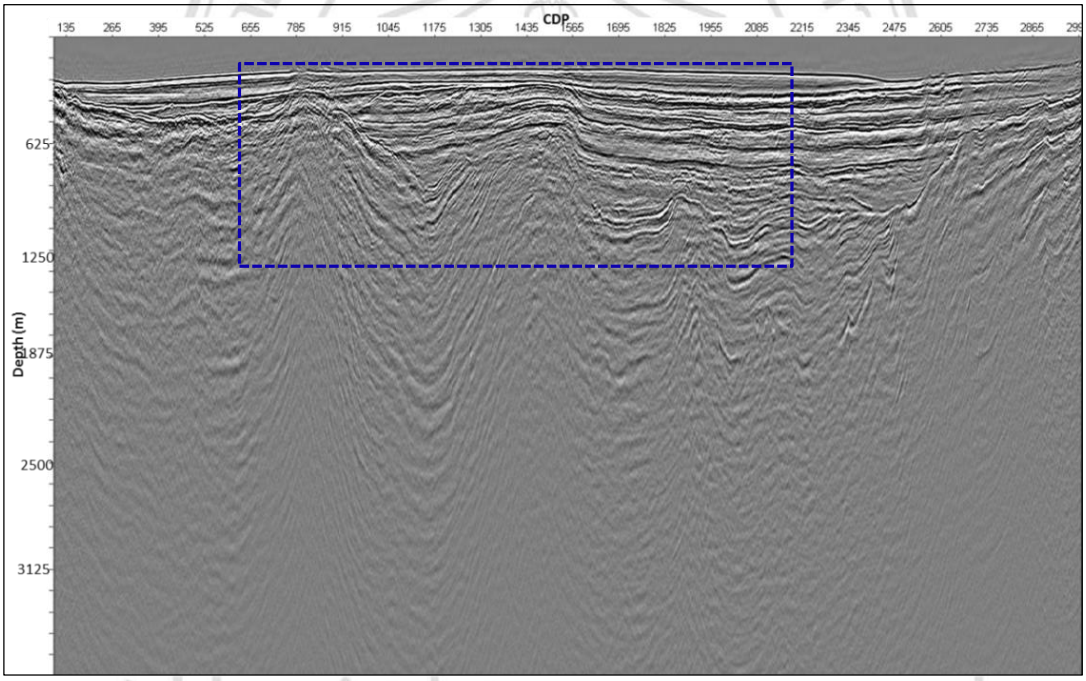

Figure 3.29 WSS160-Shelikof Strait, Gazdag migrated section in Cartesian coordinate system.

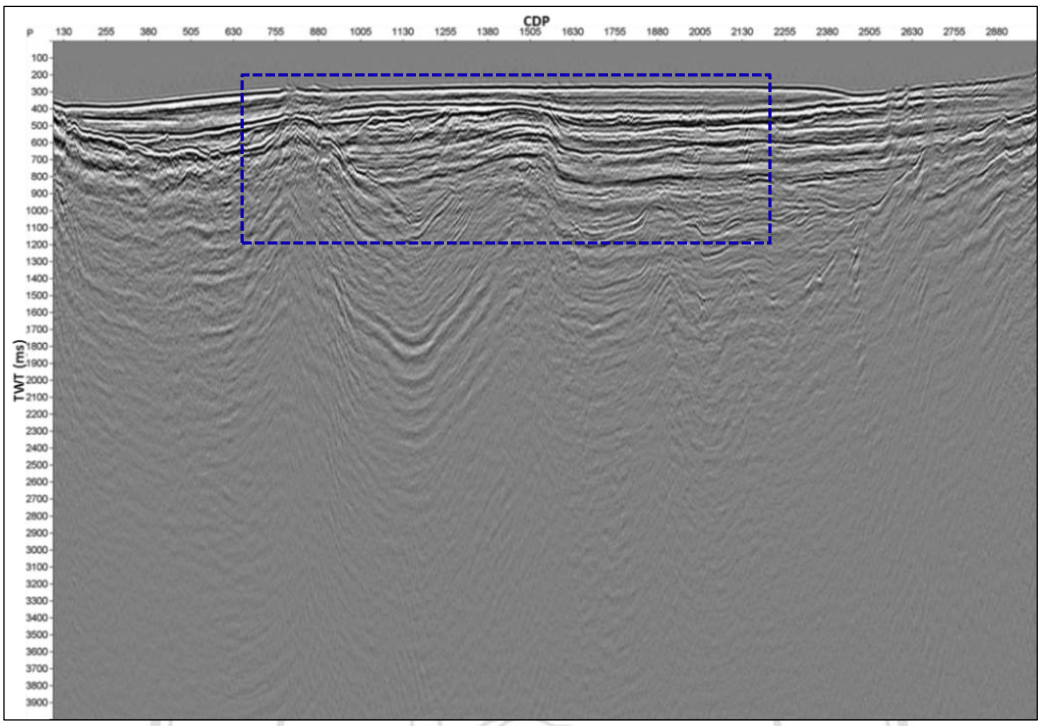

Figure 3.30 WSS160-Shelikof Strait, 15-degree Finite-difference migrated section in Cartesian coordinate system.

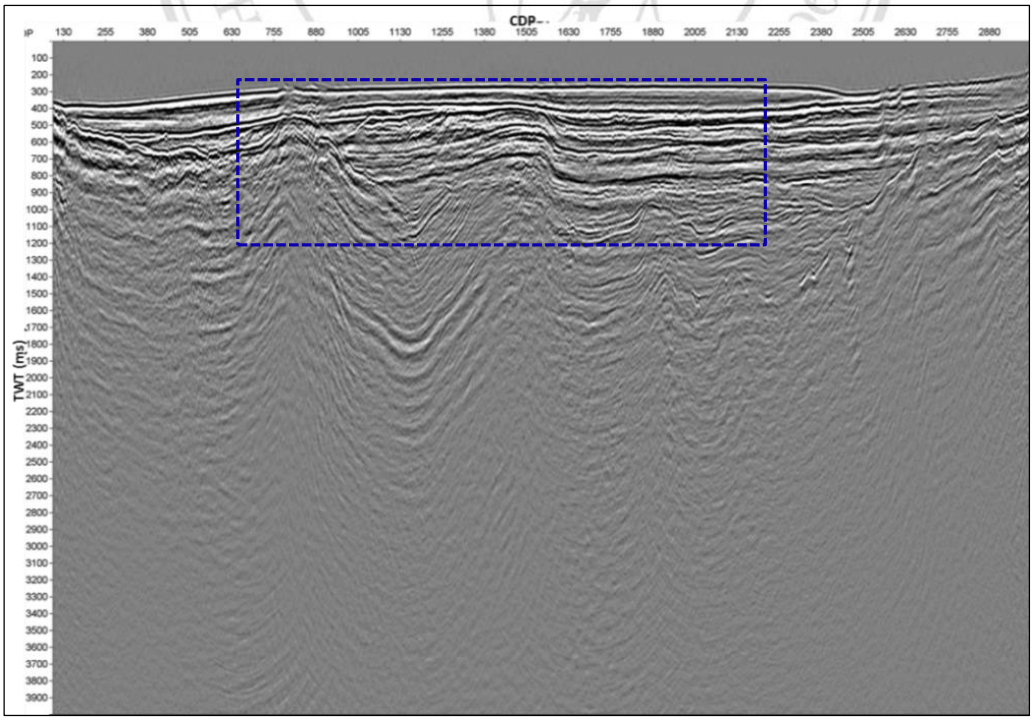

Figure 3.31 WSS160-Shelikof Strait, 15-degree Finite-difference migrated section in log-polar coordinate system.

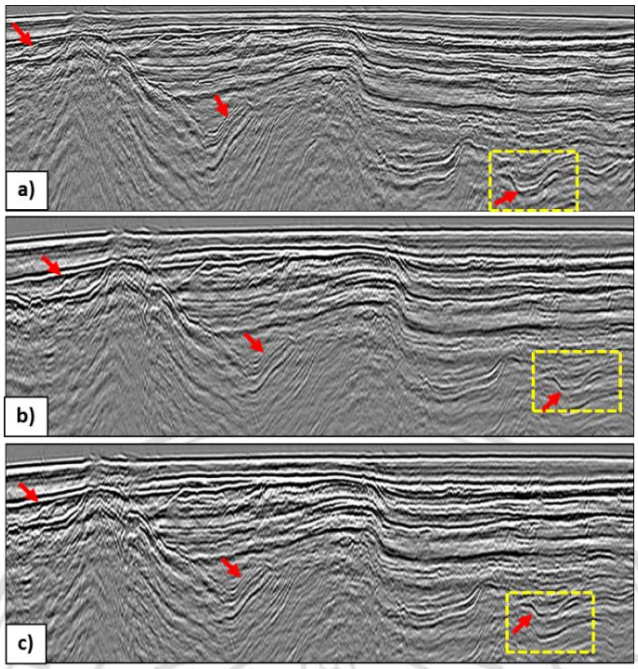

Figure 3.32 Shallow part of WSS160-Shelikof Strait: a) Gazdag migrated section in Cartesian b) 15-degree Finite-difference migrated section in Cartesian c) 15-degree Finite-difference migrated section in log-polar coordinate systems.

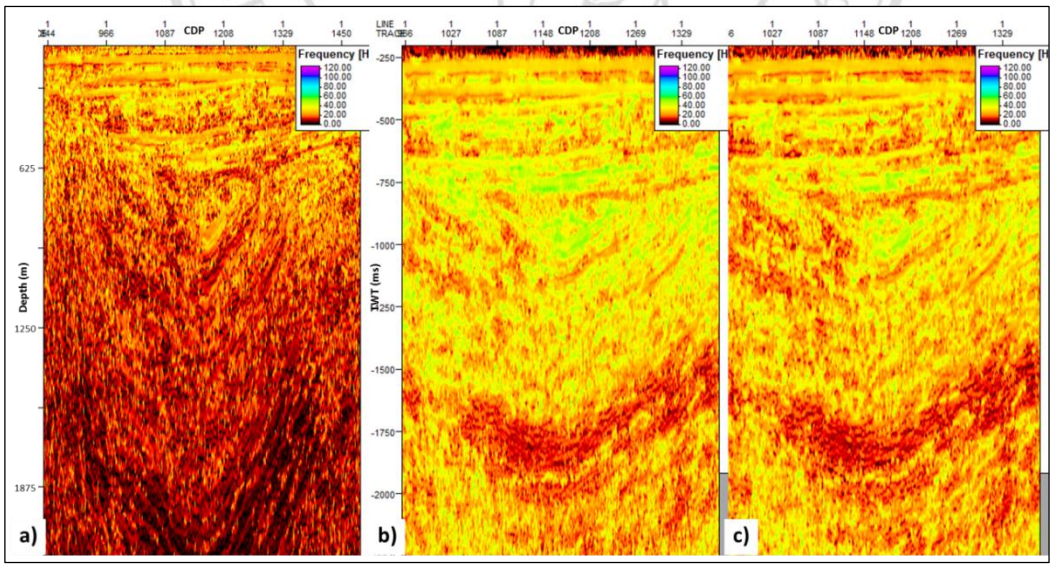

Figure 3.33 Instantaneous frequency of WSS160-Shelikof Strait: a) Gazdag migrated section in Cartesian b) 15-degree Finite-difference migrated section in Cartesian c) 15-degree Finite-difference migrated section in log-polar coordinate system.

3.6 Post-stack migration result of WNS324-Norton Sound, Alaska

In Figure 3.34, Figure 3.35 and Figure 3.36, Gazdag migrated section in Cartesain and the 15-degree Finite-difference migrated sections of WNS324-Norton Sound in Cartesian and log-polar coordinate systems are shown, respectively. At the shallow part of the section, Gazdag migrated section in Cartesian shows high resolution but for 15-degree Finite-difference there is no clear difference between two coordinate systems, while differences in imaging are presented by the yellow square at the deeper part of the section. The estimated instantaneous frequency of both coordinate systems show that the 15-degree Finite-difference migrated section in log-polar coordinate has a bit lower frequency than Cartesian coordinate system but higher than Gazdag migrated section in Cartesian as seen in Figure 3.38a, Figure 3.38b and Figure 3.38c highlight the differences between two coordinate systems, higher resolution subsections of the image, within yellow squares in Figure 3.37a, Figure 3.37b and Figure 3.37c show the reflector's cross each other in Gazdag migration in Cartesian and 15-degree Finite-difference in Cartesian coordinate systems. The geological structure looks realistic in 15-degree Finite-difference log-polar. The correct velocity is required to image complex structural geology. Without having that correct model, imaging steep dip reflectors using high angle propagated waves, is wasting time especially when dealing with depth migration.

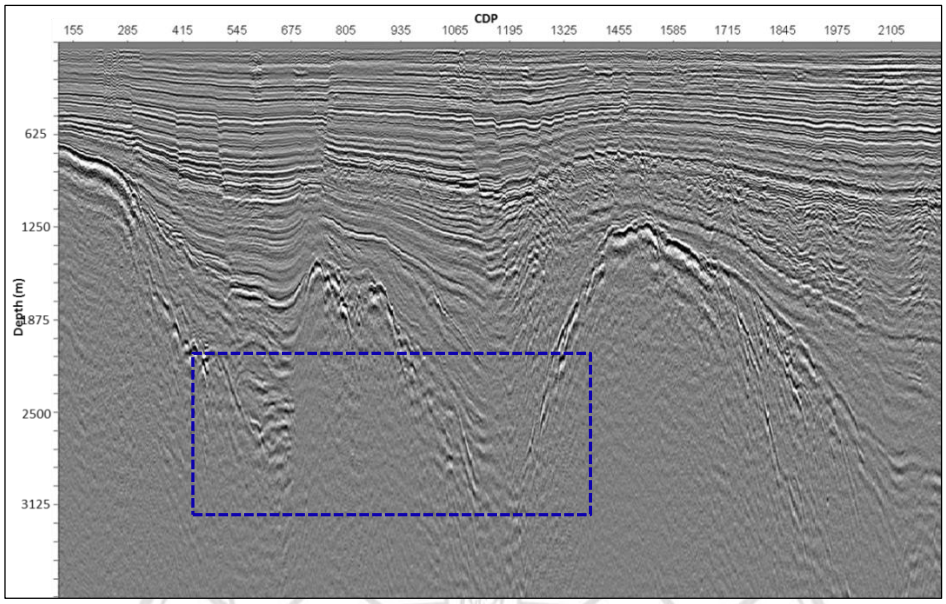

Figure 3.34 WNS324-Norton Sound, Gazdag migrated section in Cartesian coordinate system.

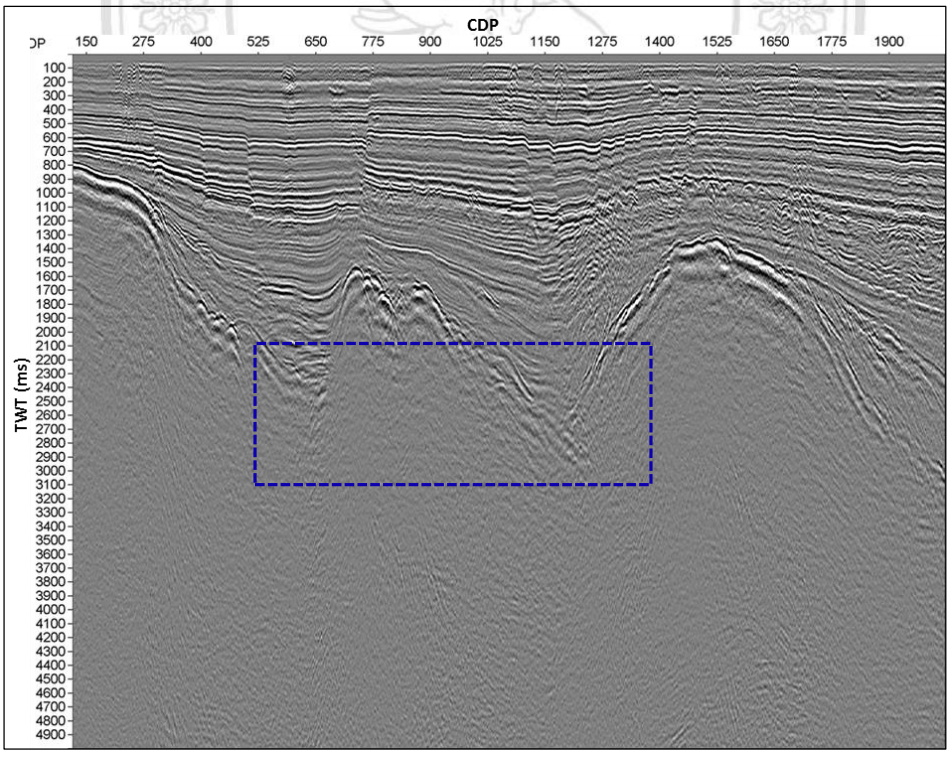

Figure 3.35 WNS324-Norton Sound, 15-degree Finite-difference migrated section in Cartesian coordinate system.

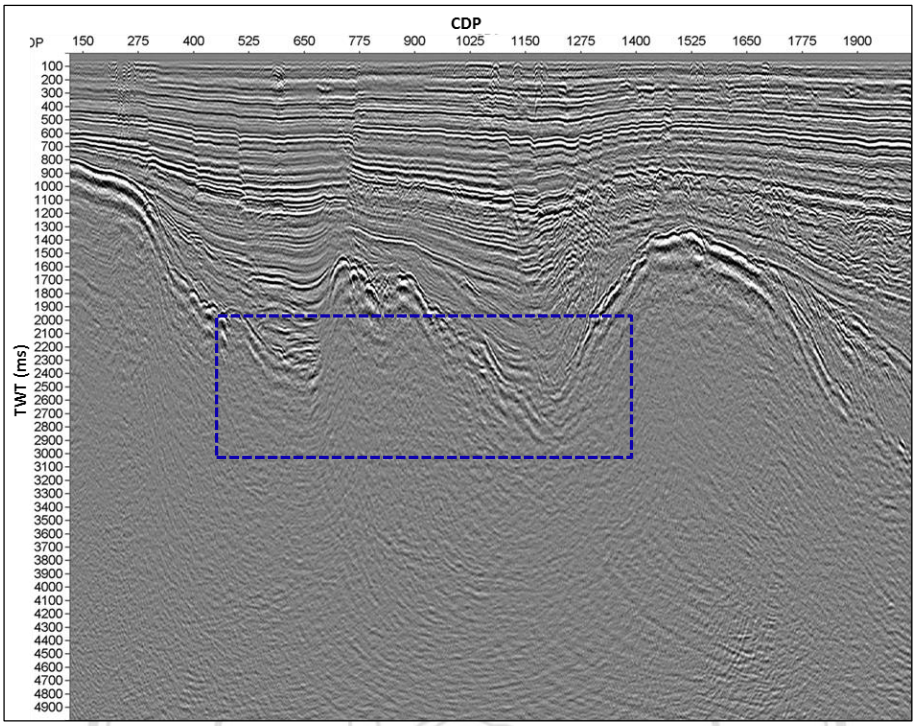

Figure 3.36 WNS324-Norton Sound, 15-degree Finite-difference migrated section in log-polar coordinate system.

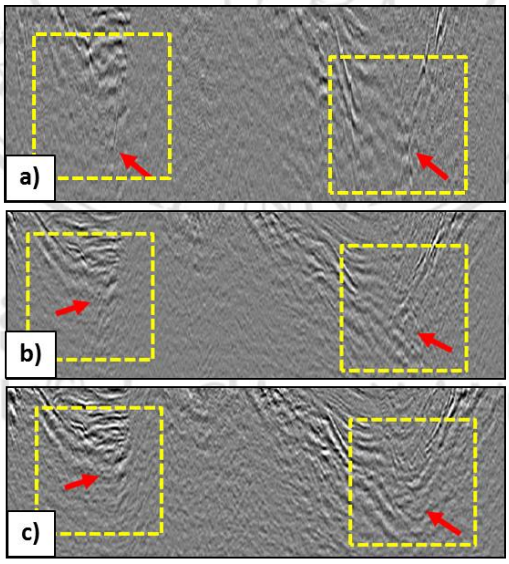

Figure 3.37 Deeper part of WNS324-Norton Sound: a) Gazdag migrated section in Cartesian b) 15-degree Finite-difference migrated section in Cartesian c) 15-degree Finite-difference migrated section in log-polar coordinate systems.

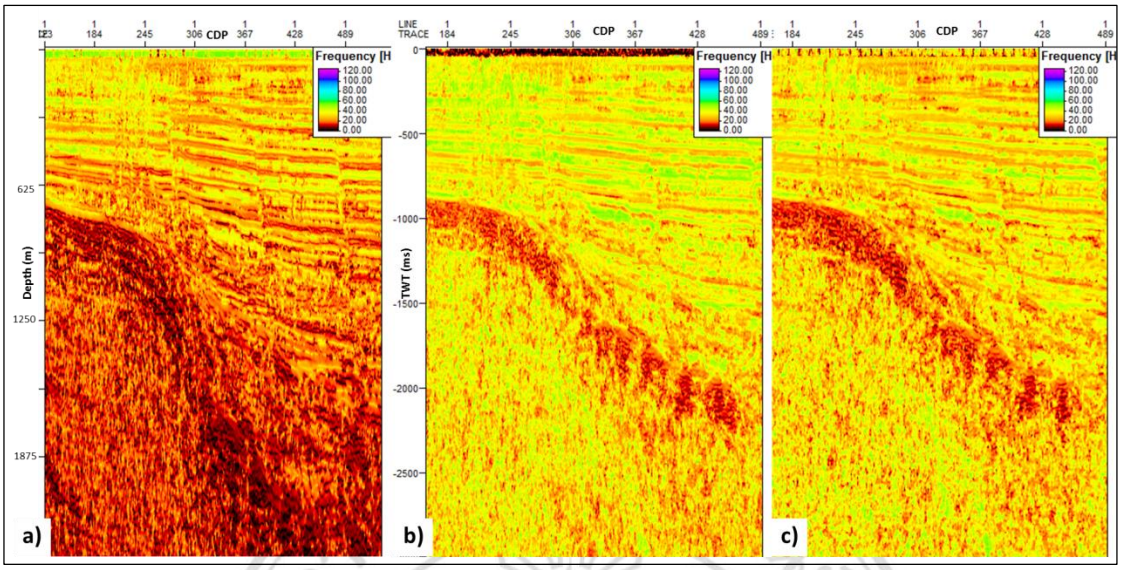

Figure 3.38 Instantaneous frequency of WNS324-Norton Sound: a) Gazdag migrated section in Cartesian b) 15-degree Finite-difference migrated section in Cartesian c) 15-degree Finite-difference migrated section in log-polar coordinate system.

3.7 Post-stack migration result of WNS325-Norton Sound, Alaska

In Figure 3.39, Figure 3.40 and Figure 3.41 the Gazdag and 15-degree Finite-difference migrated sections of WNS325-Norton Sound in Cartesian and log-polar coordinate systems are shown, respectively. The areas highlighted by the yellow circles show the difference between Gazdag in Cartesian and 15-degree Finite-difference in two coordinates and it can be seen that the shallow part was mostly imaged similarly in Gazdag in Cartesian and 15-degree Finite-difference both coordinate systems which were shown in Figure 3.42a, Figure 3.42b and Figure 3.42c. In Figure 3.43a, Figure 3.43b and Figure 3.43c the estimated instantaneous frequency of Gazdag in Cartesian and 15-degree Finite-difference in Cartesian and log-polar coordinate system are shown, respectively. The results show that 15-degree Finite-difference in log-polar coordinate system has a frequency slightly lower than 15-degree Finite-difference in Cartesian coordinate system. In the highlighted areas, shown in Figure 3.39, Figure 3.40 and Figure 3.41, it is possible to see that the fault plane in 15-degree Finite-difference in log-polar was imaged clearly compared to Gazdag and 15-degree Finite-difference in Cartesian coordinate system.

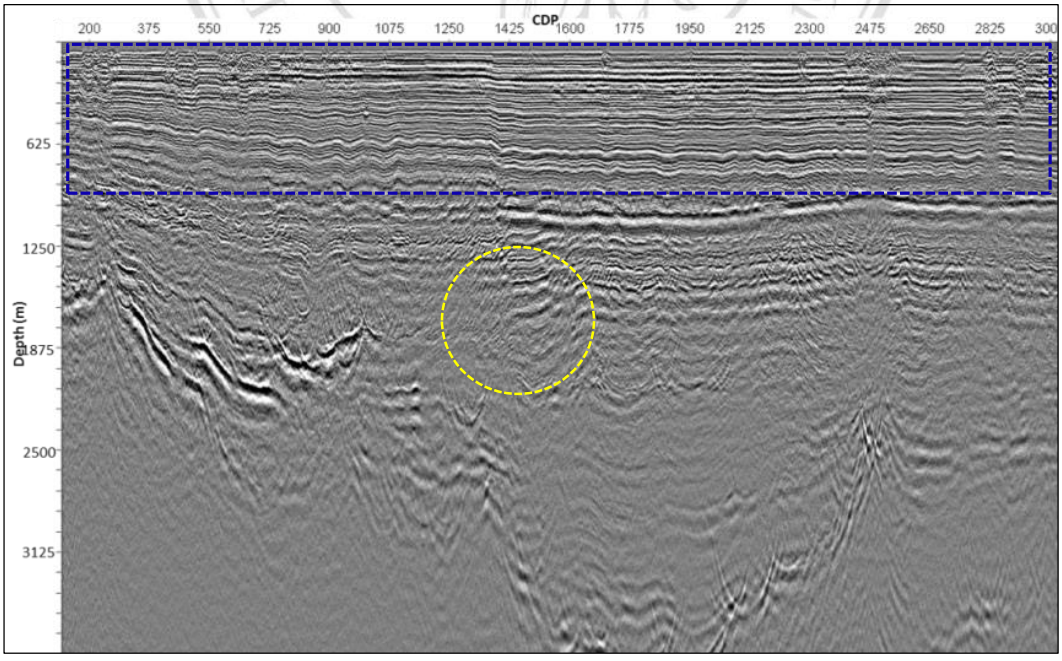

Figure 3.39 WNS325-Norton Sound, Gazdag migrated section in Cartesian coordinate system.

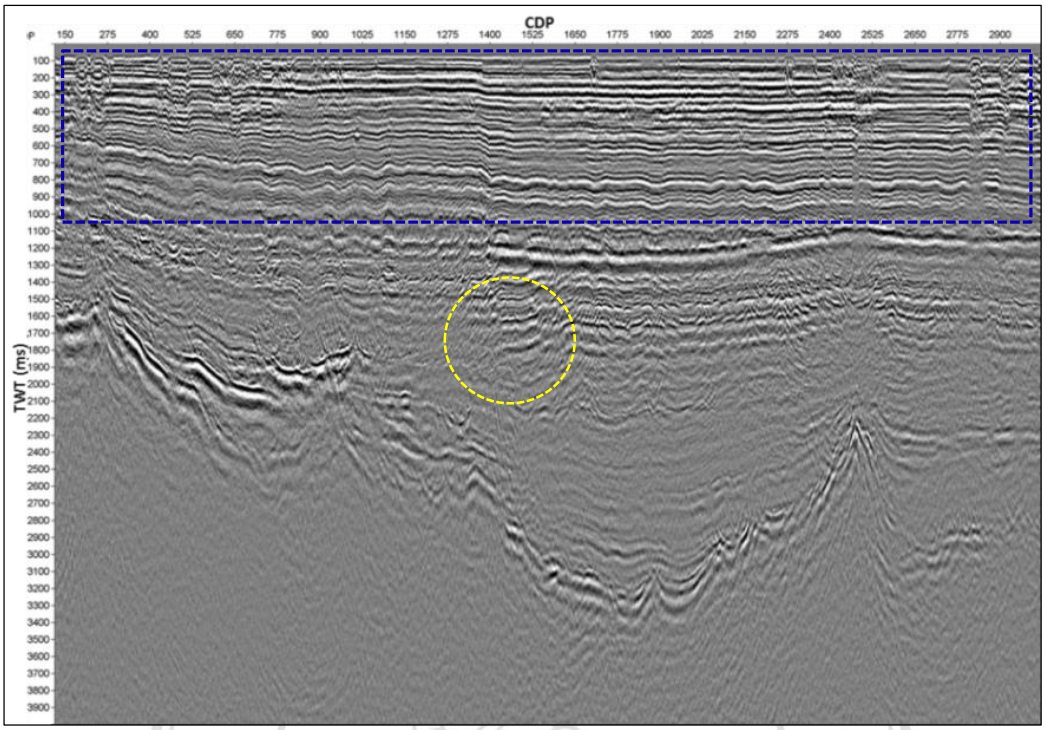

Figure 3.40 WNS324-Norton Sound, 15-degree Finite-difference migrated section in Cartesian coordinate system.

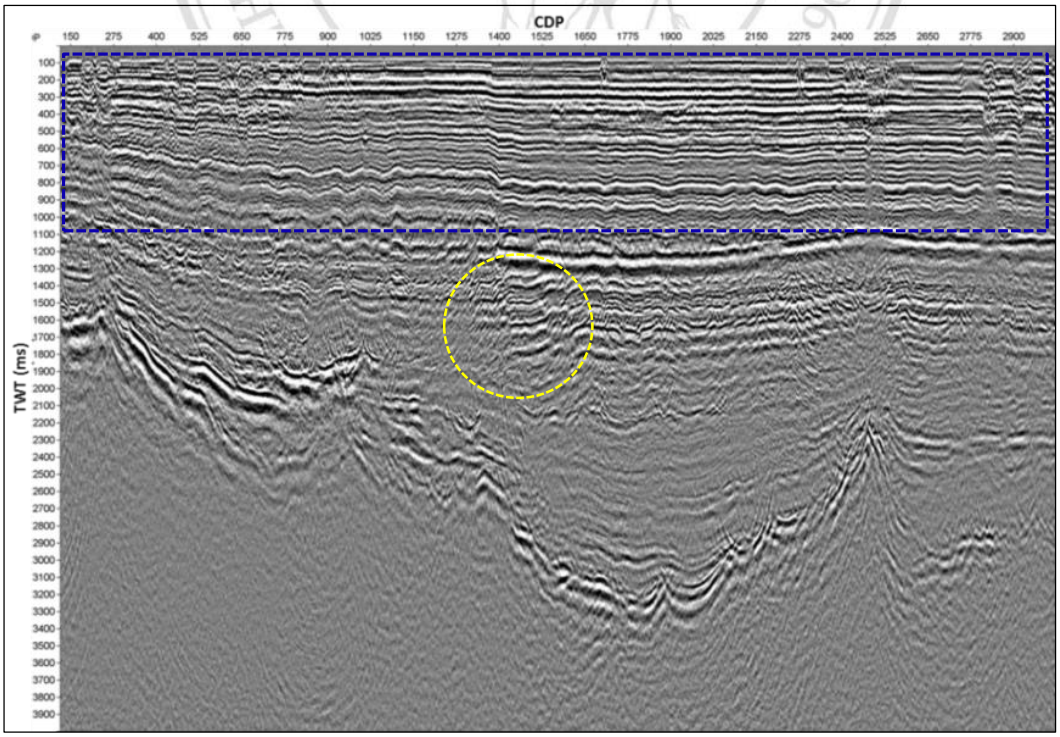

Figure 3.41 WNS325-Norton Sound, 15-degree Finite-difference migrated section in log-polar coordinate system.

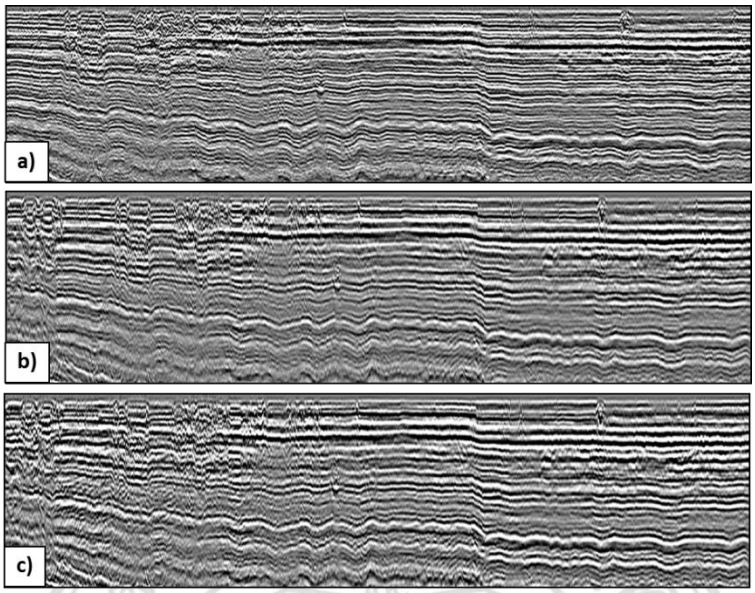

Figure 3.42 Shallow part of WNS325-Norton Sound: a) Gazdag migrated section in Cartesian b) 15-degree Finite-difference migrated section in Cartesian c) 15-degree Finite-difference migrated section in log-polar coordinate systems.

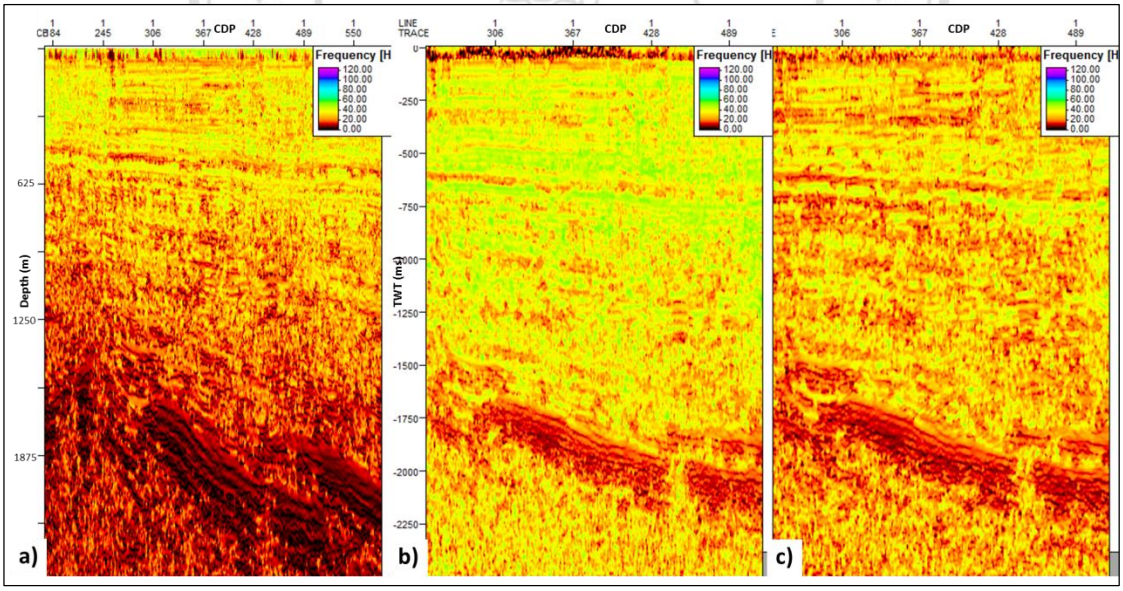

Figure 3.43 Instantaneous frequency of WNS325-Norton Sound: a) Gazdag migrated section in Cartesian b) 15-degree Finite-difference migrated section in Cartesian c) 15-degree Finite-difference migrated section in log-polar coordinate system.