

Study of Microseism and Microtremor

density in the microtremor band for all the stations have been shown in figure 4.

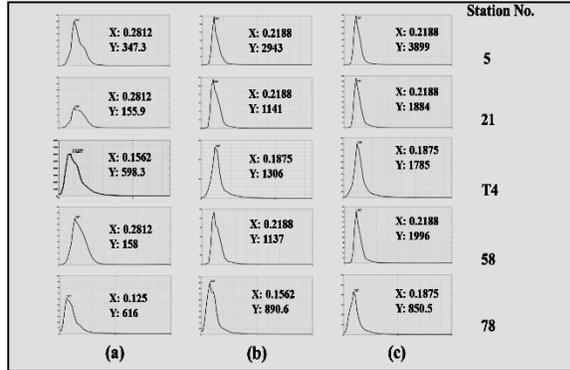


Figure 3: Represents the power spectral density curve (X-axis-spectral density, Y-axis-frequency (Hz)) for the stations in the microseism band (0.05-0.5Hz), 3(a) is PSD for Z-component, 3(b) is PSD for N-S component & 3(c) is PSD for E-W component.

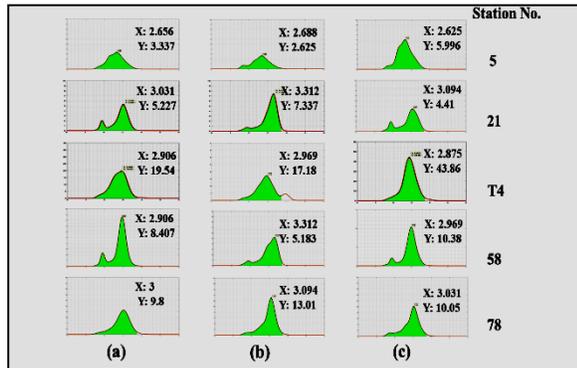


Figure 4: Represents the power spectral density curve (X-axis-spectral density, Y-axis-frequency (Hz)) for the stations in the microtremor band (1.5-3.5Hz), 4(a) is PSD for Z-component, 4(b) is PSD for N-S component & 4(c) is PSD for E-W component.

It is observed from the figure 3 & figure 4 that the Z-component is significantly less as compared to both the N-S & E-W component. The quantification in reduction in peaks of PSD in microseism band has been shown in figure 5 & 6 as the percentage of reduction with respect to E-W & N-S component.

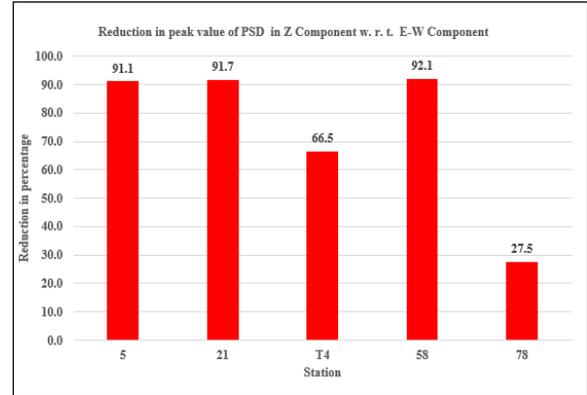


Figure 5: Histogram represents the reduction of peak value of power spectral density in Z-component w. r. t. E-W component in the microseism band.

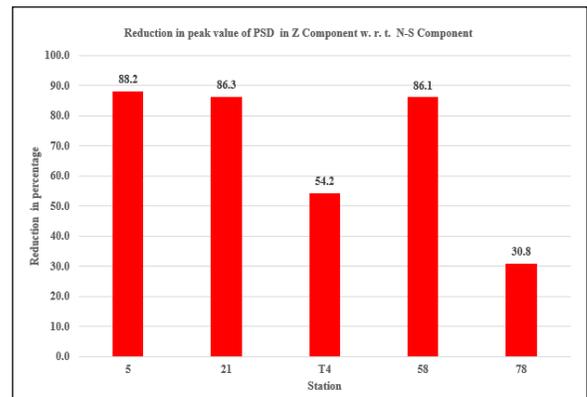


Figure 6: Histogram represents the reduction of peak value of power spectral density in Z-component w. r. t. N-S component in the microseism band.

The peak value from the power spectral density curve for both the frequency bands have been picked and plotted in histogram plots figure 7 & 8.

Study of Microseism and Microtremor

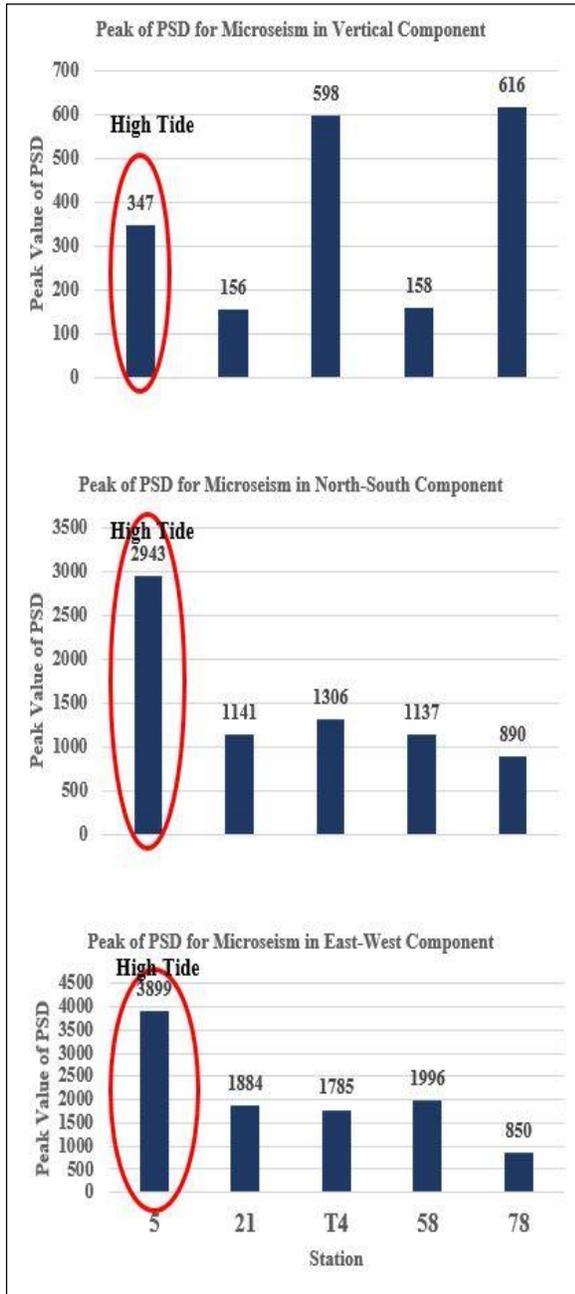


Figure 7: Histogram represents the peak value of power spectral density for the stations in the microseism band (0.05-0.5Hz), for Z-component, N-S, & E-W component.

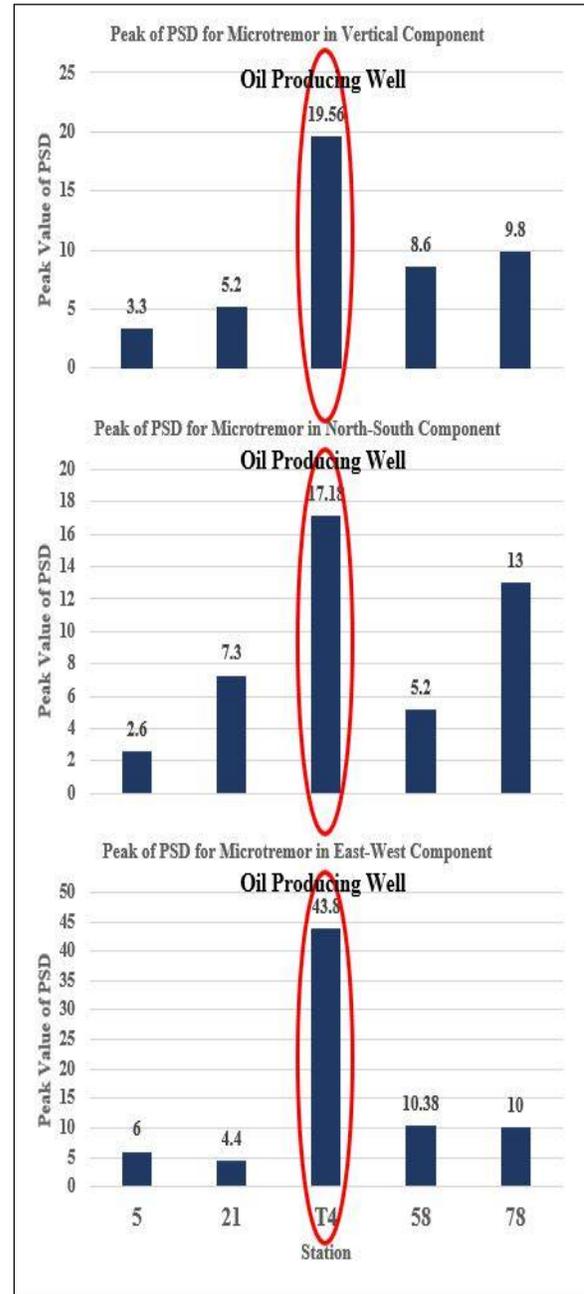


Figure 8: Histogram represents the peak value of power spectral density for the in the microtremor band (1.5-3.5Hz), for Z-component, N-S & E-W component.

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Discussion

Insights into the spectral peaks of microseisms reveals that there is a significant drop of the amplitude levels in the Z-component of the data as compared to the horizontal components, there is as much as 30-88% of drop in the spectral peak of the PSD of Z-component compared to N-S component & 27-92% of drop as compared to E-W component of all the stations. As pointed out by Haubrich et. al., 1963 microseisms are mainly characterized by surface waves including both Rayleigh and Love waves. Here the dominance of the horizontal component suggests the surface waves mainly Rayleigh & Love waves.

The high response in the spectral peak of horizontal components at station 5 (figure 7) is attributed to the high tide, which have been marked with red ellipse. Station 5 data was acquired on 16.06.2019 and it was a high tide on that day as per the tide coefficient at Gulf of Khambat.

If we see the spectral peaks in microtremor band, there is a spectacular response at T4 which is mainly at 3 Hz (figure 8). T4 station is a location of oil producing well in the region. The high response at T4 in the microtremor band, mainly at 3Hz is being attributed to hydrocarbon reserve. Dangel et al, 2003, & Holzner et al., 2005 also established the spectral anomaly between 2-3 Hz associated with hydrocarbon reservoir.

Conclusions

The very high amplitude value of horizontal component as compared to the Z-component suggests there is prevalence of surface waves mainly Rayleigh & Love waves.

Microseism activity is confined within the frequency band (0.12-0.28) Hz.

The horizontal components respond to the tide in microseism band with high peak value at station 5.

The high response in the spectral peak at 3Hz in the microtremor band is attributed to the hydrocarbon reserves.

However, if we compare the response of microseism and microtremor simultaneously (figure 7 & 8) there is no effect of tide activity in the microtremor response.

There seems to be no correlation between the microseism and microtremor response at those 5 stations under consideration. But it is very difficult to imagine any ambient seismic activity without microseisms. More data from different basins need to be studied to acquire more comprehensive knowledge on the subject.

References

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Study of Microseism and Microtremor

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Tides data have been taken from www.tides4fishing.com

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Views expressed in this paper are that of the author(s) only and may not necessarily be of ONGC.