



DYNAMIC CHARACTERISTICS OF SOIL USING GEOPHYSICAL TECHNIQUES IN ATBARA AREA, SUDAN

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Abstract:

In Atbara area, many industrial factories, roads and bridges have been constructed. Geophysical techniques are mainly used in planning for these strategic projects and to study and determine the soil characteristics to avoid the associated problems during and after construction. In the present study shallow seismic refraction technique was carried out to determine the lateral extension and dynamics properties of the layers. A set of profiles with a 24 channel for vertical geophones were used to generate P-waves. Travel-time versus distance graphs were constructed, velocities and the thickness of the three subsurface layers in the study area were determined. The final results show that P-wave velocities ranges from 248 m/s to 498m/s, 596m/s - 1005m/s and 908 m/s -1896 m/s for the first, second and third layer, respectively. The subsurface layers stratigraphy was delineate using the geological cross sections which were obtained from boreholes data. The comparison between the geological cross sections and the H/V spectral ratio which was obtained from the previous study was performed. Finally, it will conclude that the shallow seismic refraction and H/V spectral ratio techniques are one of the most effective methods which are very useful for building and other civil engineering purposes.

Introduction:

Geophysical techniques are mainly used in planning for the strategic projects. They were used to study and determine the soil characteristics to avoid the associated problems with and after construction.

Numerous researchers have used these techniques to determine the characteristics of the sites and delineate any mechanism for changing mechanic properties such as Telford *et al.*, (1985E), Abd El-Aal (2002) and Jazlan *et al.*, (2015). Other scientists have used the site effects and an integrated approach to compare the H/V ratio and the subsurface layers in order to through the light on the dynamic properties of soil such as Nakamura (1989, 1996 and 2000). Recently Atbara area witnessed development in buildings of many industrial activities such as a lot of cement factories around the town and expected the development of building, bridges. Therefore the specific information about the environment and pattern of rock bodies will definitely provide productive information for planners and decision makers to use and manage resources.

This study focus on the dynamics characteristics of soil and subsurface layers stratigraphy in Atbara area based on P and S wave velocity, H/V results (Khalda *et al.*, 2015), the geological cross section which was created using borehole data and geo-electrical cross section (modified after AAAID, 2006).

The Study area and data:

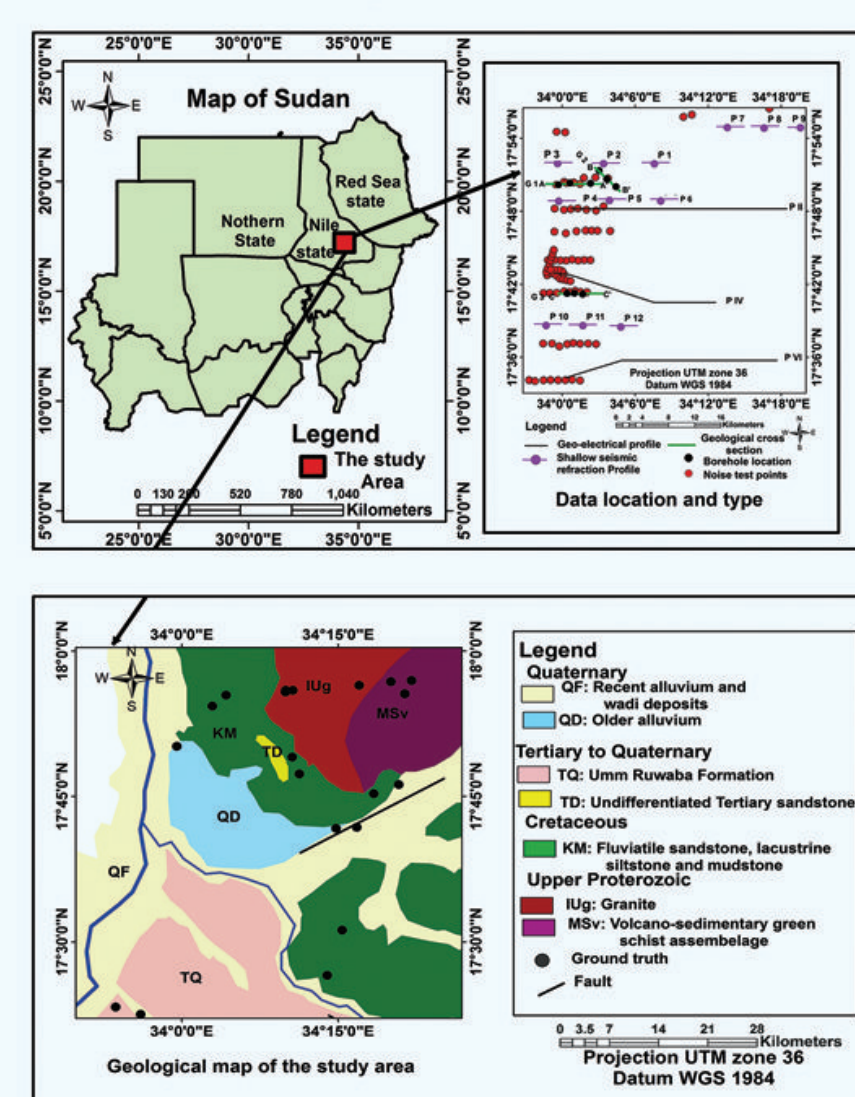


Fig.1: Reveals the study area and data

Method:

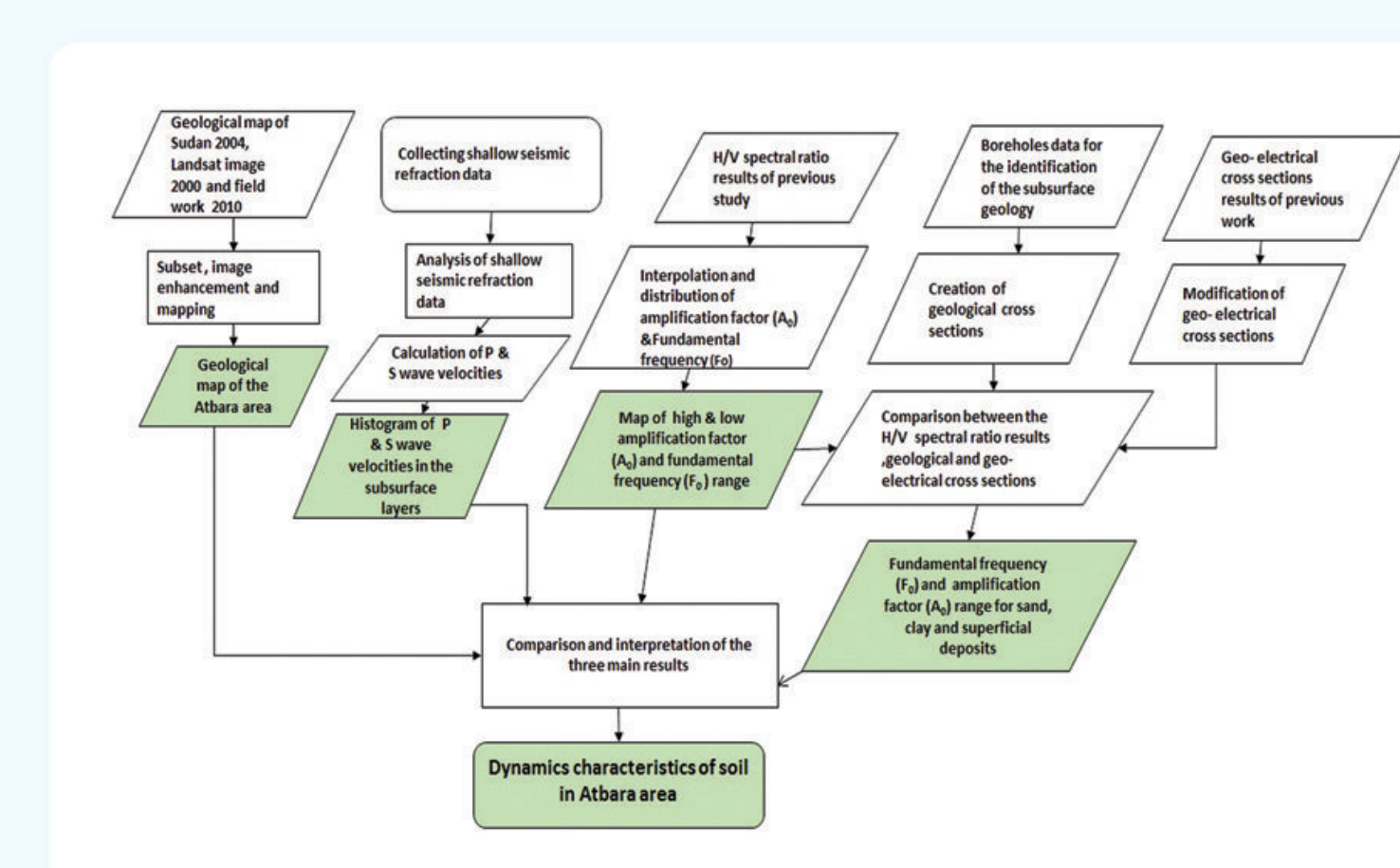


Fig.2: Flow chart of method

Results:

The final results illustrated that the subsurface structures characterizing the shallow seismic profiles consists mainly of three. The P-wave velocities ranges of 248 m/s to 498m/s, 596m/s - 1005m/s and 908 m/s -1896 m/s for the first, second and third layer, respectively. Figure (3) the interpolation for the Amplification Factor (Ao) displays the area of high amplification factor of brown color reach to 9.6 and the distribution of the fundamental frequency (Fo) which is ranged between 0.72 and 3.2 Hz. Figure (4) histogram displays the P, S waves velocities for the three layer.

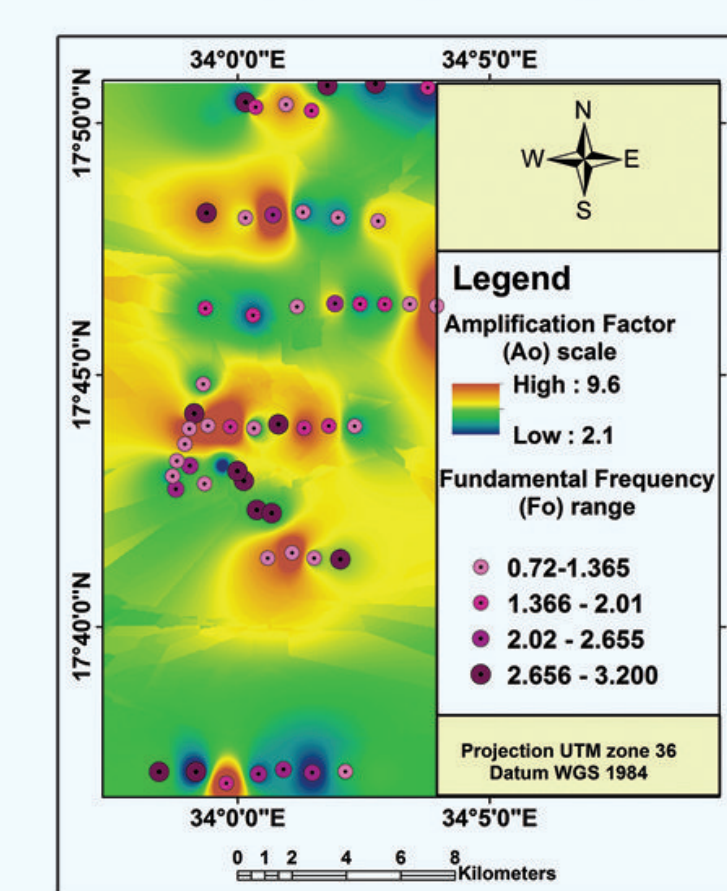


Fig.3: Distribution of amplification factor & fundamental frequency

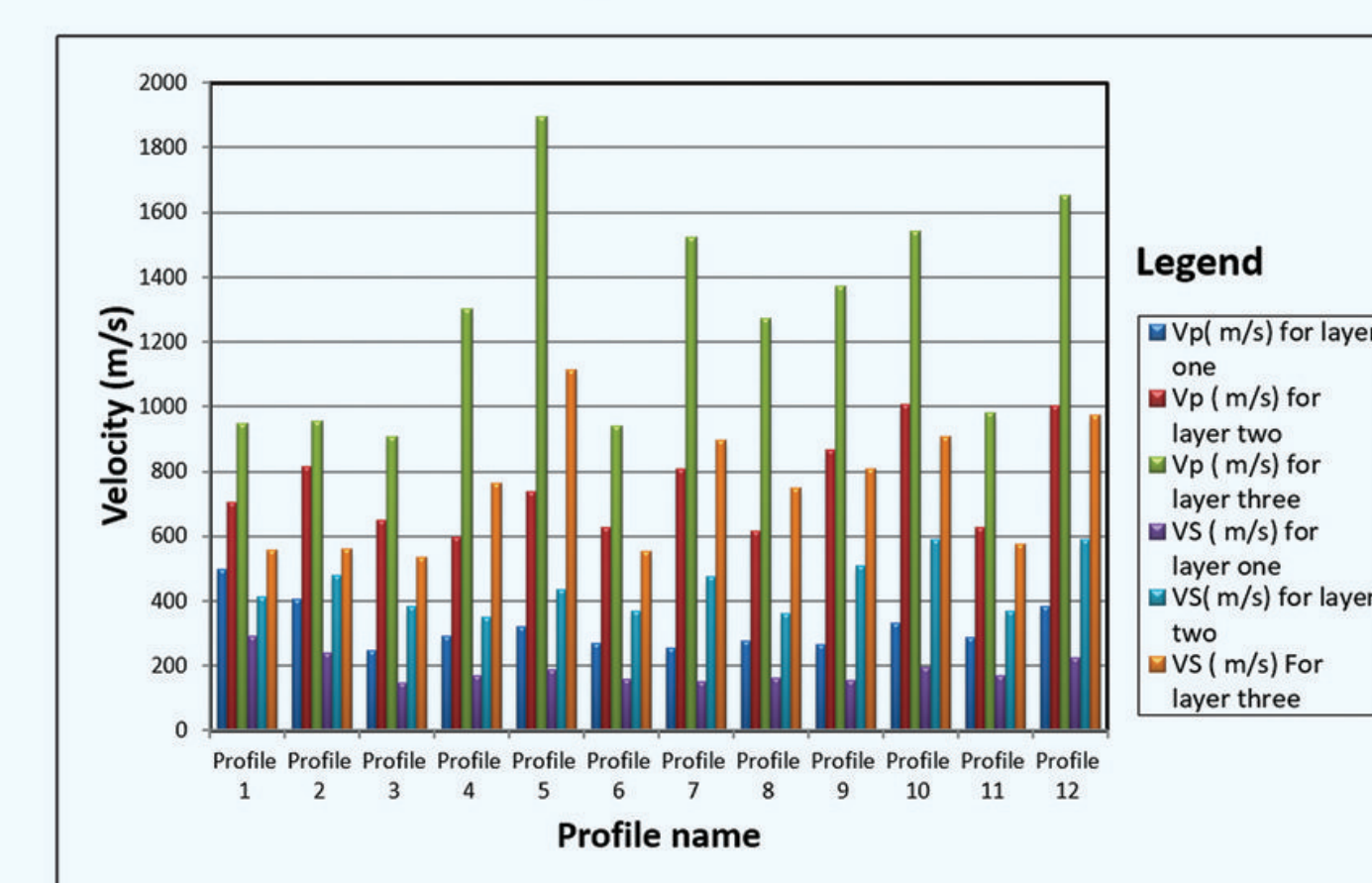


Fig.4: Histogram display the P&S-wave velocities in m/s for the subsurface layers

Comparison between H/V spectral ratio results (Khalda *et al.*, 2015) and geological cross sections represents the fundamental frequency deduced from the surface layer which is mainly composed of sandstone is ranged between 1.1 and 2.3Hz and the amplification factor between 2.9 and 6.3. While the fundamental frequency of the first layer that is consisted of clay is between 0.86 and 0.97 Hz and the amplification factor is ranges from 4.2 to 5.7. Figure (5 a, b and c) displays the comparison between H/V spectral ratio and the geological cross sections.

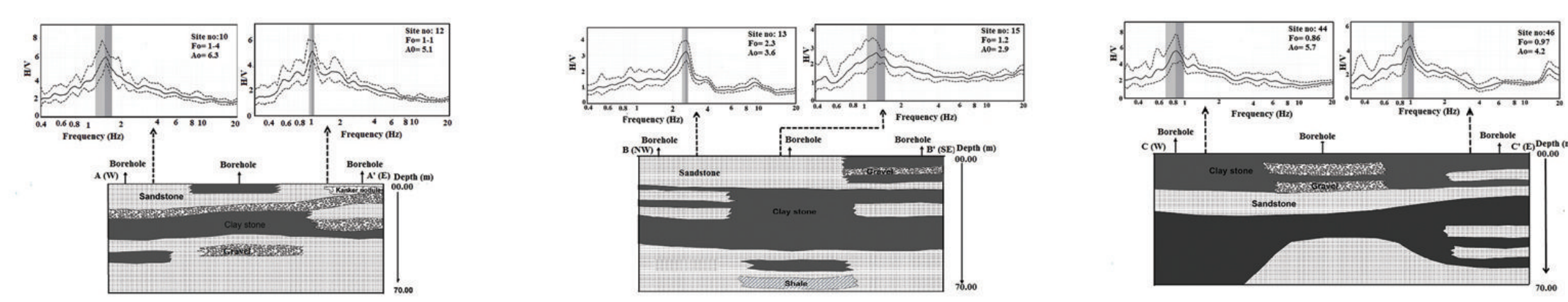


Fig.5: The comparison between H/V spectral ratio results and the geological cross sections.

Comparison between H/V spectral ratio results and geo-electrical cross sections demonstrates that the first layer formed of sandstone intercalated with clay has fundamental frequency ranges from 0.72 Hz to 1.5 Hz a and the amplification factor is between 2.7 and 8.5 while the fundamental frequency of the first layer which is composed of superficial deposits is ranged between 0.86 to 2.5 Hz and the amplification factor is about 2.3 and 5.4. Figure (6) reveals the comparison between H/V spectral ratio and the geo-electrical cross sections.

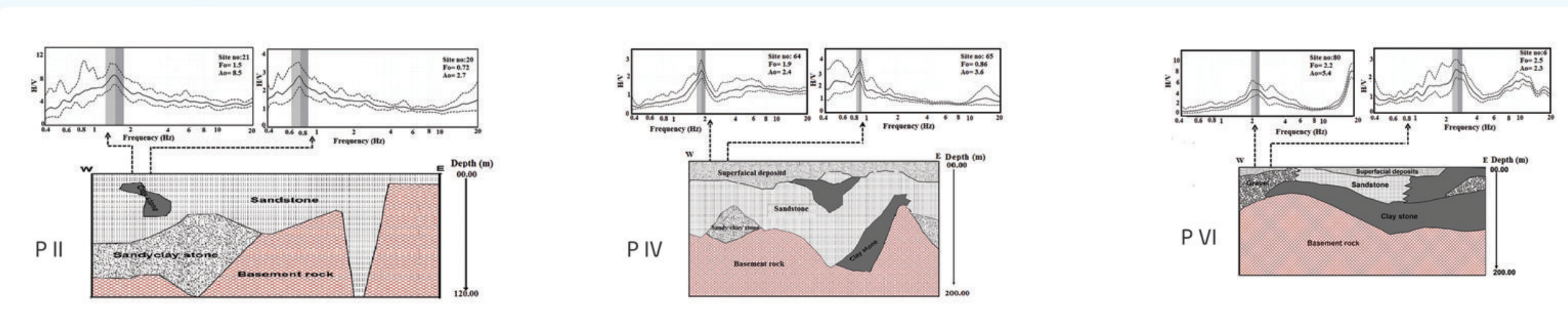


Fig.6: The comparison between H/V spectral ratio results and the geo-electrical cross sections.

Conclusion:

Generally, the P-waves velocity is an effective parameter for determining the stiffness or bearing capacity of materials. The P-wave velocity for the top layer is consistent and is found to be about 248 m/s to 498 m/s for 0.2 m to 3 m, in this range of velocity can be interpreted as the organic materials in the soil or superficial deposits. The H/V spectral ratio results demonstrate that the fundamental frequency of the sites lies on Quaternary, Tertiary and Cretaceous sediments is range from 0.72 to 3.3, 1.3 to 2.4 and 1.2 to 2.6 Hz, respectively and the amplification factor around 2.2 to 9.6, 2.4 to 5.3 and 2.9 to 3.8, respectively. These results compared to the modified geo-electrical sections (after, AAAID 2006) and the geological cross sections which are used for the identification of the subsurface geology confirm the existence of three subsurface layers. On the other hand, the comparison between the H/V results and the subsurface layers provided the low dominant frequency of the upper layer which indicates vulnerability of this layer to earthquake activity. It is quite clear that the first layer has low dynamic properties which should be considered in the future plans and more detailed investigation should be carried out for safety purposes.

Data sources:

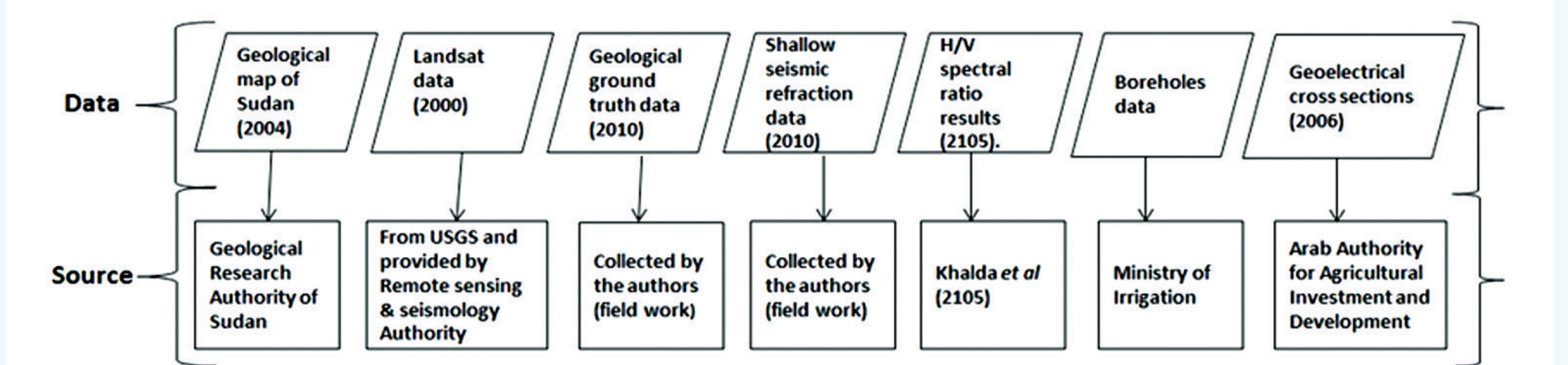


Fig.7: Data sources flow diagram

Acknowledgement:

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