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Sedimentology and Lithostratigraphy of Paleozoic Sedimentary Successions of Northern Ethiopia

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Paleozoic sedimentary successions of Ethiopia form a very important chapter in Ethiopian Geology. Present study is a re-examination of such successions in northern Ethiopia, deposited in continental environments, in the light of modern concepts of depositional environments and litho-facies. Although they have very poor preservation potential, as they are dominated by erosional activities, deposits of continental environments are noticed in the study area. They are mappable, although occurring in patches, unconformably overlying the Proterozoic metamorphic basement rocks. The Paleozoic sedimentary lithostratigraphic units ESF (Enticho Sandstone Formation) and ATF (Adaga Arbi Tillite Formation) are totally different in their lithological characters. ESF is dominated by medium to coarse, cross-bedded, moderately sorted, white sandstones with occasional occurrence of muddy lenses rich in iron oxide and oligomectic conglomerates. The large size of cross-bedding as well as textural inversion of well-rounded and sub-angular grains suggest aeolian influence during deposition of this unit in a braided and meandering fluvial setting, the outwash of reworked glacial materials.

ATF is characterized by the dominance of ferruginous, mud-matrix rich, un-stratified, unsorted tillites with large size, angular boulders derived from Precambrian source and deposited by glaciers. ESF is regarded as older and ATF younger by many workers on the basis of field occurrences. The former is overlain by the latter but often the reverse field relationship is also observed. However, there is no doubt about their glacial origin. At certain localities, in ATF, a muddy lithology with thin layers (varves) has also been observed with interrupted layers of mud by large and angular embedded dropstones. This unit, although rare in occurrence, clearly indicates their deposition in a pro-glacial lacustrine environment.

Therefore, a glacio-lacustrine-fluvial depositional model is suggested on the basis of lithological characters of the Paleozoic sedimentary successions of the study area. Successive episodes of three parallel depositional environments are responsible for the development of three different litho-facies associations during Paleozoic Era. This is the reason why sometimes ESF is overlain by ATF and vice versa. An interfingering relationship of these two lithostratigraphic units seems to be more logical than independent entities. This model explains the simultaneous occurrence of three environmements (Glacial – Lake - River) producing three different litho-facies (Till - Varve with dropstones - Sand). During the Paleozoic Era, many such episodes were responsible for the production of thick successions on the peneplaned basements towards the terminal part of glacier sheets melting and producing lake/fluvial systems.