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Assessment of Pedogenic Evolution of Zeolites and Associated Minerals at a Representative Site of Baramati, Pune

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Abstract–*The role of zeolites and associated minerals were assessed for pedogenic evolution of soils through geological and mineralogical analysis of a representative site at Baramati, Pune. Zeolites minerals were identified and characterised in the field as well as in the laboratory using petrographic microscope and X-ray diffraction (XRD), whereas, shape, size, structure as well as elemental composition were investigated using scanning electron microscope (SEM),Transmission Electron Microscope (TEM) and energy dispersive x-ray spectrometer (EDX), and nature of particles were identified based on high energy electron diffraction (HEED), whereas, ^{14}C Dating were used for determining the age of soil formation and development for their nutrient status. The presence of vesicular and non-vesicular basalt with distinct physical characteristics was observed. Vesicular basalts were dominantly coarse grained, hydrothermally altered and rich in zeolites, whereas, non-vesicular basalt were fine grained, very hard and compact. Both the rocks were dominated by plagioclase feldspar, pyroxenes, olivine, glass and iron oxide minerals and were in phase of transformation and neomineralization to secondary clay minerals thereby releasing their cations to the soil system. Study indicated zeolites were predominantly sodic (mordenite, mesolite) and calcic (okenite, prehnite, gyrolite, scolecite, heulandite, stilbite) as well as fluorine rich (apophyllite). Heulandite and stilbite were the dominant zeolite minerals in soil and are invariably fractured and weathered, resulting the release of Ca to the soil system as observed in EDX analysis of fresh and weathered minerals. The presence of crystalline zeolite along and within the lava lobes, their subsequent weathering and Ca leaching leading to a calcic horizon below the soil surface indicated the level of degradation.Study indicated particle size varies from 50-500nm and forms from ovular, rounded, prismatic, irregular and rod shaped due to differences in chemical composition. It has also been observed that with the decrease of particle size, there is higher release of calcium and sodium to the soil system in comparison to larger particle size probably due to increase in the reactive surface area and also due to monocrystalline as well as polycrystalline nature of zeolite minerals. Soils were very shallow, gravelly sandy loam and very poor in organic carbon, highly degraded and are of recent age of formation (650 to 910yr).*

Key words: Pedogenic evolution, Zeolites and associated minerals, Calcic horizon, Soil degradation