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The contribution of micrometeorites to the iron stocks of buried podzols, developed in Late-glacial aeolian sand deposits (Brabant, The Netherlands)

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The surface geology of an extensive part of NW-Europe is dominated by coversands (Late-glacial chemical poor aeolian sand deposits). The geomorphology of coversand landscapes is dominated by ridges and planes. Podzolation is the dominant soil forming process in coversands under moderate humid climatic conditions. Umbric Podzols developed on the ridges under Quercetum-mixtum, Gleyic and Histic Podzols developed in the planes under Alnetum. Even in chemical poor coversands, iron will be released by hydrolysis from iron containing silicate minerals (such as feldspars). It is well known that the vertical iron distribution in Podzols is effected by translocation of active iron from eluvial to illuvial horizons and that iron is leaching to the aquifer. Iron stocks of Podzols, in contrasts, have not been widely studied for comparison purposes of individual soil horizons or between soils. We determined the stocks of active and immobile iron in the horizons of buried xeromorphic Podzols (soils that developed without any contact with groundwater). The results show that the total amount of iron exceeds the potential amount which can be released by hydrolysis from the parent material. Furthermore, to amount of iron that leached to the groundwater is unknown. It is evident that we must find an additional source to explain the total iron stocks in buried Podzols. It is known from analysis of ice cores that the earth atmosphere is subjected to a continuous influx of (iron rich) micrometeorites. The precipitation of micrometeorites (and other aerosols) on the earth surface is concentrated in humid climatic zones with (intensive) rain fall. We analyzed minerals, extracted from the ectorganic horizon of the Initial Podzols, developed in driftsand that stabilized around 1900 AD, overlying Palaeopodzols, buried around 1200 AD. Among blown in quartz grains, we could determine also micrometeorites, embedded in the organic skeleton of the fermentation horizon of the Initial Podzol (Mormoder). The exogenic origin of the micrometeorites could be confirmed by SEM-EDX analysis. Micrometeorites could accumulate on the surface level of the Initial Podzols during one century (between 1900 AD till the moment of sampling in 2013), on the surface level of the buried Podzols during eight millennia (between the moment of stabilization in the Preboreal and the moment of burying around 1200 AD). The soil conditions of the ectorganic horizons of (initial) Podzols are moist and acidic, promoting quick release of iron from micrometeorites. An additional source of Iron that could be added to the amount, released from the parent material. The extraction and identification of micrometeorites from ectorganic horizons of Initial Podzols helped illustrate that atmospheric deposition in the form of aerosol and aeolian (e.g. Saharan) dust, micrometeorites and other hydrolysable particles, contributes to soil development. The requisite active iron for podzolation can therefore be derived from chemical weathering of atmospheric iron sources in the acidic soil environment.

Reference: 1. Van Mourik, J.M., Seijmonsbergen, A.C., Slotboom, R.T. and Wallinga, J., 2012. The impact of human land use on soils and landforms in cultural landscapes on aeolian sandy substrates (Maashorst, SE Netherlands). Quaternary International 265, 74-89. 2. Van Mourik, J.M. and de Vet, S.B. (2015). Iron stocks of buried Podzols: endogenic iron deficits and potential exogenic enrichment in the Maashorst region, SE Netherlands. Catena, accepted.