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Visualizing and quantifying pore space geometry of two contrasting soil aggregates

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Soil aggregate formation and functional processes are important mechanisms controlling the unsaturated flux and mineral sorption of organic moieties controlling the long term sequestration of soil carbon (C). However, research during the last 50 years produced few quantitative mechanisms controlling the interactive effects between soil biota and soil physical processes at the micro-scale. Pore network geometries and continuities within soil aggregates determine the flux of air, water and nutrients that control these process-level interactions within microbial microsites. Expanding clay minerals also increase their internal porosities during repeated drying and rewetting (D/W) cycles, adding new micro-pores and fissures that transport and store substantial inorganic and organic substrates within aggregate interiors. Advances in X-ray synchrotron micro-tomography and the development of algorithms that quantify pore demographics within media greatly facilitate detailed pore analyses of soil aggregates at the microsite level. Statistical analyses of pore throat size, pore channel length and connectivity as well as pore size distributions within aggregates will transform our understanding of diffusion processes. Lindquist and Venkatarangan (2000) have developed a suite of algorithms which extract specific pore geometries from 3D data sets. To test the performance and applicability of these algorithms - which originally have been developed for sandstone samples - for aggregated soil samples with primary and secondary pores we have analyzed two contrasting soil aggregates (˜ 5mm across). Samples were collected from a Hortic Anthrosol derived from loess from an experimental farm in southern Germany (Rotthalmünster). One aggregate is derived from the ploughed horizon of a conventionally managed soil (CT) and the second

one from a relictic ploughed layer of a plot which has been converted into grassland in 1961 (Jasinska, 2006). As soil texture is almost identical in both plots differences in pore systems may be attributed predominantly to soil structure forming processes which in turn is influenced by the management system. However, primary goal of this investigation is to quantify pore space characteristics of contrasting soil aggregates by 3D image analysis. Should such 3D pore space quantification prove to be sensitive in displaying differences in pore space architecture it will significantly facilitate the interpretation of soil aggregate related site functions. One example could be the explanation of management specific carbon sequestration properties on a bio-physical basis.