Nicole Dzenowski is now working on her M.Sc. degree at Ohio University, where her thesis is related to the paleosols and continental ichnofossils of the Glenshaw Formation; she is also interested in the neo-ichnology of ambrystomid salamanders. Her advisor is Dr. Daniel Hembree.

In this project, paleosols and ichnofossils within the Late Pennsylvanian Glenshaw Formation of southeast Ohio will be studied to aid in the paleoenvironmental and paleoecological reconstruction of the Late Pennsylvanian landscape of the distal Appalachian basin. This will allow for a more accurate understanding of Pennsylvanian environmental and climatic conditions of this region than previously interpreted through the use of sedimentology and body fossils alone. The Late Pennsylvanian is characterized by a shift from humid climates to drier climates. It is hypothesized that this global shift towards drier climates as well as local environmental variability will be detectable through changes in the paleosols and continental ichnofossils of the Glenshaw Formation.

A paleosol is a fossilized soil that formed on an ancient landscape that is indicative of past ecological, environmental and climatic conditions (Retallack, 2001). Quaternary paleosols have long been recognized and studied, but interest in pre-Quaternary paleosols has increased with paleosols commonly being recognized in strata dating as far back as the Precambrian (Kraus, 1999). Current knowledge and understanding of such soil forming factors as climate, parent material, soil organisms, topography and time, and their effect on soil formation make paleosols invaluable tools in reconstruction of paleoenvironment, paleoclimate, and paleoecology (Retallack, 2001; Schaetzl and Anderson, 2009).

Ichnofossils are preserved biogenic structures which results from the life activities of an organism within or on a medium (Bromley, 2006). When preserved *in situ*, unlike body fossils, ichnofossils are tangible representations of behaviors and organism response to the surrounding environments. These properties make ichnofossils invaluable in paleoenvironmental, paleoecological and paleoclimatic reconstruction (Rhoads, 1975; Bromley, 2006). Marine ichnofossils are well-documented and through neo-ichnological studies, behaviors and environmental factors controlling their morphology have been accurately determined (Frey, 1975; Dörjes et al., 1975; Bromley, 1996; Gingras et al., 2002, 2004). While the study of continental ichnology is relatively new, the same methods can be applied for understanding the behaviors and environmental factors involved in the occurrence and morphology of continental ichnofossils (Hasiotis, 2003; Hembree *et al.*, 2004; Hembree and Hasiotis, 2008; Smith and Hasiotis, 2008).

The Glenshaw Formation (Late Pennsylvanian, Kasimovian-Gzhelian (305 – 302 Ma)) is located in the Lower Conemaugh Group in the Central Appalachian basin. The Glenshaw is approximately 60-100 meters thick and was deposited in the distal portion of the central Appalachian Basin. The strata of the Glenshaw consists primarily of sandstone and mudstone units with thin limestone and coal beds, that have been interpreted as the deposits of alluvial, deltaic, and shallow-marine environments (Martino, 2004). The Glenshaw Formation contains many well-developed cyclothems that have been described by both Busch and Rollins (1984), who identified eleven cyclothem sequences in the northern portion of the Appalachian Basin in Ohio and Pennsylvania, and Martino (2004), who identified nine in the Dunkard basin along the southernmost Ohio and West Virginia border (Greb *et al.*, 2008). These cyclothems are representative of a series of eight separate transgressive and regressive events that occurred during the deposition of the Glenshaw (Martino, 2004; Greb *et al.*, 2008). The more inland nature of the Glenshaw Formation in southeast Ohio makes it an ideal location for studying Pennsylvanian paleosols, resulting in thicker paleosols and thinner marine sequences than are present further into the Appalachian Basin (Nadon and Kelly, 2004). Red and green paleosols are common within the Glenshaw Formation at the base of the transgressive and regressive sequences (Martino, 2004; Greb *et al.*, 2008).

Field work will be conducted in Athens County, Ohio. Three, 20-50 meter sections will excavated below the Ames Limestone at the East State Street/Highway 33 exit (39˚19’41.58”N 82˚05’46”W). General stratigraphic sections detailing the lithology of each 20 meter trench will be constructed. Trenches will then be extended laterally 3-5 meters where paleosols are located. Paleosols will be described and sampled in 10 cm intervals and detailed stratigraphic columns will be made for each one. Paleosol and mottle coloring will be taken using dry samples and a Munsell Rock-Color chart (Munsell, 1991). Horizons, texture, and lithology, as well as nodule, rhizolith and ichnofossil type, abundance and distribution will be documented and used in paleosol classification as well as final paleoenvironmental and paleoecological reconstruction. The type, sharpness, and lateral continuity of horizons will aid in understanding conditions under which the paleosols formed. This, along with composition and distribution of pedogenic nodules will be useful in determining the drainage conditions as well as the amount and seasonality of precipitation. The abundance, type and orientation (horizontal versus vertical) of both burrows and rhizoliths will be important in the interpretation of subaerial conditions, drainage conditions of the soil, and location of the water table.

Four to five thin sections will be made per paleosol, with at least one thin section made per paleosol horizon. Thin sections will be observed for plasmic fabrics and pedogenic microfabrics using a polarizing microscope. The microfabric will be classified according to methods outlined by Brewer (1976). Thin sections will be used to determine the average grain size of the paleosols, the presence of illuviated clays, and to observe rhizoliths and biogenic structures not visible in hand samples. Thin sections will also be made for any large, well-preserved burrows found and used to better identify burrow linings, fill lithology and means of fill (active or passive).

Ichnofossils found will be assigned to the appropriate ichnogenera and ichnospecies based upon general architecture, structure of linings present, branching, and fill type. All ichnofossils will be interpreted for the behaviors that they represent (e.g. resting, feeding, dwelling, respiration), their potential trace makers, and their paleoenvironmental significance based upon established continental neo-ichnological research. Changes in ichnofabric within and between paleosols will be assessed, and through cluster analyses, ichnocoenoses will be determined based on ichnofossil distribution and abundance within interpreted faunal communities. These interpretations will be used in conjunction with other physical properties of the paleosols in determining drainage conditions of the soil, details of the soil environment and ecology, local environmental conditions, and climate of southeast Ohio during the Late Pennsylvanian.

Initial field work has been conducted in the Glenshaw Formation in Athens County showing that there are paleosols located within the formation. Within the paleosols, rhizoliths and burrows have been identified. Through further investigation it is expected that traces from soil invertebrates such as arachnids, millipedes, scorpions and other arthropods will be observed within the paleosols with the possibility of traces of fossorial vertebrates such as the microsaurs, temnospondyls, and cotylosaurs. These traces will allow for new paleoenvironmental and paleoecological interpretations of the Late Pennsylvanian in southeastern Ohio.

References Cited

Brewer, R., 1976, Fabric and Mineral Analysis of Soils (2nd ed.): Krieger, Huntington, NY.

Bromley, R.G., 1996, Trace Fossils: Biology, taphonomy, and applications: Chapman and Hall, London, 361 p.

Busch, R. M., and H. B. Rollins, 1984, Correlation of Carboniferous strata using a hierarchy of transgressive regressive units: Geology, v. 12, p. 471–474

Condit, D. Dale., 1909, The Conemaugh Formation in southern Ohio: The Ohio Naturalist, v. 4, p. 482-488.

Dörjes, J. and Hertweck, G., 1975, Recent biocoenoses and ichnococenosis in shallow-water marine environments, *in* Frey, R.W., The Study of Trace Fossils: A Synthesis of Principals, Problems and Procedures in Ichnology: Springer-Verlag, New York, p. 459-491.

Frey, R.W., 1975, The Study of Trace Fossils: A synthesis of Principals, Problems, and Procedures in Ichnology: Springer-Verlang, New York, p. 147-160.

Greb, S.F., Pashin, J.C., Martino, R.L., Eble, C.F., Frank, T.D., editor, and Isbell, J.L., editor, 2008, Appalachian sedimentary cycles during the Pennsylvanian; changing influences of sea level, climate, and tectonics: Special Paper - Geological Society of America, v. 441, p. 235-248.

Hasiotis, S.T., 2003, Complex ichnofossils of solitary and social soil organisms; understanding their evolution and roles in terrestrial paleoecosystems: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 192, p. 259-320.

Hembree, D.I., and Hasiotis, S.T., 2006, The Identification and interpretation of reptile ichnofossils in paleosols through modern studies: Journal of Sedimentary Research, v. 76, p. 575-588.

Hembree, D.I. and Hasiotis, S.T., 2008, Miocene vertebrate and invertebrate burrows defining compound

paleosols in the Pawnee Creek Formation, Colorado, U.S.A: Palaeogeography, Palaeoclimatology, Palaeoecology, v. 270, p. 349-365.

Hembree, D. I., Martin, L., and Hasiotis, S. T. 2004. Amphibian burrows and ephemeral ponds of the lower Permian Speiser Shale, Kansas: Evidence for seasonality in the Midcontinent. Palaeogeography, Palaeoclimatology,Palaeoecology, p. 583-593.

Kraus, M.J., 1999, Paleosols in clastic sedimentary rocks: their geologic applications: Earth-Science Reviews, v. 47, p. 41–70.

Mack, G.H., James, W.C., Monger, H.C., 1993, Classification of paleosols: Geol. Soc. Am. Bull. 105, 129–136

Martino, R. L., 2004, Sequence stratigraphy of the Glenshaw Formation (middle – late Pennsylvanian) in the central Appalachian basin, *in* J.C. Pashin and R.A. Gastaldo, eds., Sequence stratigraphy, paleoclimate, and tectonics of coal-bearing strata: AAPG Studies in Geology, v. 51, p. 1-28.

Munsell Color. 2001. Munsell Rock Color Charts. Munsell Color, Baltimore, Maryland.

Nadon, G.C. and Kelly, R.R., 2004, The constraints of glacial eustasy and low accommodation on sequence-stratigraphic interpretations of Pennsylvanian strata, Conemaugh Group, Appalachian basin, U.S.A., Sequence stratigraphy, paleoclimate, and tectonics of coal-bearing strata: AAPG Studies in Geology 51, p 29-44.

Retallack, G.J., 2001, Soils of the past: an introduction to paleopedology (2d ed.): Oxford, Blackwell Science, 404 p.

Smith, J.J., and Hasiotis, S.T., 2008, Traces and burrowing behaviors of the cicada nymph Cicadetta calliope; neoichnology and paleoecological significance of extant soil-dwelling insects: Palaios, v. 23, p. 503-513.

Soil Survey Staff. 1996, Soil survey laboratory methods manual. Soil Survey Investigations Rep. 42, Version 3.0. USDA-NRCS, Lincoln, NE.

Schaezl, R., and Anderson, S., 2009, Soils: Genesis and Morphology. Cambridge University Press, Cambridge, 814 p.