# GEOCHEMICAL MODELING OF DEEP COAL MINE DISCHARGES: IRWIN SYNCLINE, PENNSYLVANIA, USA[1]

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**Abstract**: Understanding natural alkalinity production offers alternative approaches for neutralizing acid mine drainage (AMD) and has implications for predictive models, mining regulations, mine discharge remediation, and resource recovery. To determine the subsurface processes involved in the generation of natural alkalinity, we focused on infiltration rates, discharge geochemistry and overburden mineralogy of the Irwin syncline, a 240 sq.-km bituminous coal basin in southwestern Pennsylvania. The northern portion of the basin is characterized by highly acidic, iron- and aluminum-contaminated discharges. Highly alkaline, iron and sulfate-contaminated discharges dominate the southern portion (Weaver, T. J, et al., 1997, Geol. Soc. Am. Abstr. Prog., v. 29, A-321). Underground mine barrier data were used to divide the basin into six hydraulically related sub-basins; mine waters were collected from nine discharges across the basin (Winters, W.R., et al., 1999, Proc. 16th Ann. Int. Pittsburgh Coal Conf., 6-5:1-36.). A solute-modeling program (PHREEQC 2.4.2; Parkhurst and Appelo, 1999, USGS Water Res. Invest. Rept. 99-4259, 326 p) was used to put constraints on subsurface reactions. Inverse modeling results indicate that the spatial and temporal change in mine water chemistry involves processes other than simple carbonate dissolution or dilution with uncontaminated water. Acidic discharges in the northeastern end of the basin are likely the product of surface water modified by pyrite oxidation and dissolution of aluminosilicate minerals. Modeling results on the southwestern discharges are consistent with the development of net alkaline waters as a result of limestone dissolution enhanced by cation exchange reactions with overburden clays such as illite, montmorillonite and kaolinite. The data suggest these processes occur in deeper sub-basins (overburden thickness greater than 100 m). Transport models incorporating both surface water infiltration rates and interaction with neighboring mine pool waters will be developed to refine the geochemical evolution of the Irwin syncline deep mine discharges.

Additional Key Words: PHREEQC modeling, AMD

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[1]Poster was presented at the 2002 National Meeting of American Society of Mining and Reclamation, Lexington, KY, June 9-13 2002. Published by ASMR, 3134 Montavesta Rd., Lexington, KY 40502.

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