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Risks to Water Resources from Shale Gas Development and Hydraulic Fracturing in the United States

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The rise of shale gas development through horizontal drilling and high volume hydraulic fracturing has expanded oil and gas exploration in the USA. The rapid rate of shale gas exploration has triggered an intense public debate regarding the potential environmental and human health effects. A review of the updated literature has identified four potential risks for impacts on water resources: (1) stray gas contamination of shallow aquifers near shale gas sites; (2) contamination of surface water and shallow groundwater from spills, leaks, and disposal of inadequately treated wastewater or hydraulic fracturing fluids; (3) accumulation of toxic and radioactive residues in soil or stream sediments near disposal or spill sites; and (4) over-extraction of water resources for drilling and hydraulic fracturing that could induce water shortages and conflicts with other water users, particularly in water-scarce areas. As part of a long-term research on the potential water contamination associated with shale gas development, new geochemical and isotopic techniques have been developed for delineating the origin of gases and contaminants in water resource. In particular, multiple geochemical and isotopic (carbon isotopes in hydrocarbons, noble gas, strontium, boron, radium isotopes) tracers have been utilized to distinguish between naturally occurring dissolved gas and salts in water and contamination directly induced from shale gas drilling and hydraulic fracturing operations.