**INTRODUCTION**

The chemistry of a groundwater sample is composed of a mixture of dissolved ions derived from the atmosphere, rock, soil, vegetation, and anthropogenic sources. The major dissolved ions include calcium, magnesium, sodium, potassium, bicarbonate, sulfate, nitrate, chloride, and iron. The composition of these ions can affect the water quality and be used to infer the age and residence time of the groundwater.

**HYDROGEOLOGIC CROSS SECTIONS**

**Aquifer Units**

Aquifer units are regions of the Earth's subsurface that have the ability to transmit groundwater. They are defined by the permeability and thickness of the geologic materials. The aquifer units in Benton County, Minnesota, are classified into different types based on their geologic and hydrogeologic characteristics.

**Tritium**

Tritium is a naturally occurring radioactive isotope of hydrogen. Concentrations of 3H in the atmosphere were greatly increased between about 1953 and 1963 by above-ground nuclear tests (Alexander and Alexander, 1989).

**Groundwater Residence Time**

Groundwater residence time can be estimated by the level of tritium (3H) that is present in the groundwater. Tritium values in groundwater are influenced by the age of the water, the geological setting, and the processes that have occurred between the time of recharge and sampling.

**Isotope Concentrations as Evidence of Groundwater Recharge**

Isotope concentrations, such as carbon-14 (14C) and tritium (3H), can be used as indicators of groundwater recharge. Carbon-14 ages of these magnitudes indicate a shallow groundwater system that is recharged by recent precipitation.

**Pumping Effects**

Pumping of groundwater can affect the local groundwater flow and can lead to changes in water levels and quality. In some areas, pumping can create discharge zones where groundwater flows from the confined aquifer to the unconfined aquifer.

**Cross Section Explanations**

**Symbols and Legends**

- Lake or river
- Post

**References Cited**


**Figure 1** Location of hydrogeologic cross sections shown on the plate

**Figure 2** Selected water chemistry and isotope results of 96 sampled wells and additional data from the 2010 Minnesota Water Well Survey

**Figure 3** Determination of hydraulic and chemical data indicated a probable connection between a shallow buried sand unit and the Mississippi River-Sartell watershed boundary.