A hydrochemical and Dye- tracing Investigation in the Posht-e-Naz Karstic Aquifer, Alburz Mountain, Northern Iran

Kalantari N.1*, Alizadeh B.1, Mohammadi A. R.2, Keshavarzi. M.R.1

1 Geology Department, Shahid Chamran University, Ahvaz, Iran
2 Water Resource Organization, Qom, Iran

*Corresponding author, e-mail: nkalantari@hotmail.com; kalantari_n@scu.ac.ir

Abstract: A hydrochemical and tracer study (uranine injection) was conducted in Jurassic limestone of the Posht-e-Naz area in the Alborz belt to evaluate hydraulic relations between a large diameter (about 100 m) sinkhole and springs and aquifer parameters. A main goal of the project was to find out the source of turbidity of the Emarate drinking water supply spring (SP4) in rainy season. Springs discharge were measured and hydrochemical investigation were carried out. The uranine tracer was injected and eight springs, three wells and the Neka River were selected and totally 989 samples in 107 days were collected. Hydrochemical data demonstrated a relative connection between sinkhole (Sh1) and spring (SP4). The results of the tracing by sampling water indicated only a hydraulic connection between Sange-Nou spring (SP8) and injection point, while the charcoal packets analysis revealed tracer exits from spring numbers SP1, SP3, SP4, SP5, SP8, in wells W1 and W2, and in the Neka River. The concentration – time curves of charcoal packets for qualitative analysis and exit tracer for quantitative analysis is also assessed.

Key words: Posht–e-Naz; Tracing; Spring; Sinkhole; Charcoal packet

1 Study Area

The Jurassic Lar limestone with a total area of about 400 km² falls in the Alborz chain. Due to tectonics and dissolution processes, this aquifer was karstified and represents a major hydrogeological unit in the north of Iran. The Posht-e- Naz (36°34’ to 36°42’ N and 53°16’ to 53°50’ E) of mostly mountainous terrain (elevation 50-1400 m) constitute a part of the Lar formation, and covers an area of about 80 km² (Figure 1). The local population extensively depends on water from karst areas and karstic springs supply almost half of the Behshahr City drinking water needs- in particular Emarate spring. The mantled Posht-e- Naz karstic terrain with well developed karstic features (sinkhole, ponor, cave, and dry valley) has a thickness of several hundred meters (250-300 m), receives over 800 mm/y of rainfall and experiences humid climatic condition. Dense vegetation cover and relatively thick soil, cover this karst formation

Figure 1 Location map of the study area
on the top. Impermeable shales and schist of Shamshak formations (lower Jurassic) terminate the aquifer at the base.

Many karstic aquifers hold important groundwater resources that are extensively used for different purposes. At the same time, karst aquifers are seriously vulnerable to contamination resulting either from human activity or environment. Contamination can easily reach the groundwater through thin soil, swallow hole or via sinkhole, and are rapidly transported over large distances in the conduit network (Vesper et al. 2001). In general, because of specific hydrogeologic characteristics of karstic aquifers; saline water intrusion, microorganisms and turbidity are the most critical contaminants, thus karst groundwater requires specific protection. Proper management of karst aquifers needs a better knowledge of flow and transport mechanisms in these systems (Nur and Serdar 2007). Hydrochemical investigations are suitable methods for providing a scientific basis for development of sustainable groundwater protection schemes (Bakalowicz 2000, Drew and Hotzl 1999).

Water tracing is a well-developed, powerful tool of the karstic hydrologist that enables catchment boundaries to be estimated, areas of recharge to be determined and sources of pollution to be identified (Ford and Williams 1989). Groundwater tracing studies using fluorescent dyes are a commonly accepted technique to determine flow connection between accessible input and output points, to delineate karst drainage basins, and to investigate the flow behavior of karst aquifers (Zhou et al. 2002). Many groundwater problems, such as source water protection investigation, can benefit from simple point to point groundwater tracing studies (Eckenfelder 1996). A part of the Posht-e-Naz karstic aquifer is such an area where extremely susceptible to contamination by suspended particles. Therefore, a tracing test was proposed in the Posht-e-Naz karstic aquifer with aim to find out the source (sinkhole) of turbidity and to evaluate aquifer characteristics.

## 2 Results and Discussion

### 2.1 Geology

The Posht-e-Naz anticline form a part of limestone highs in the south of Behshahr City and lies almost between the Neka River in the south and the Khazar fault in the north. The study area is dominantly comprised of Jurassic Lar limestone (Figure 2), while a small part is covered by calcareous sand stone, rock avalanche and loess. In general, the water bearing Lar formation overlies impermeable Shamshak and Gorgan formations.

![Figure 2](image)

**Figure 2** Geo-morpho-hydrogeo-logical map of the study area