

**KAJIAN SPASIO - TEMPORAL HIDRODINAMIKA DAN
HIDROGEOKIMIA UNTUK KARAKTERISASI AKUIFER KARST
JONGGRANGAN, KABUPATEN KULON PROGO - PURWOREJO
(Studi Kasus Sungai Bawah Tanah Gua Anjani, Kiskendo, dan Mataair
Mudal)**

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INTISARI

Sungai Bawah Tanah (SBT) Gua Kiskendo, Mataair Mudal, dan SBT Gua Anjani merupakan bagian dari Karst Jonggrangan yang memiliki nilai penting bagi masyarakat. Karakterisasi akuifer terkait perkembangan akuifer karst perlu dilakukan untuk menunjang pengelolaan sumberdaya air secara berkelanjutan, baik dari segi kuantitas maupun kualitas. Penelitian ini bertujuan untuk: (1) mengkaji kondisi hidrodinamika secara spasial dan temporal; (2) mengkaji kondisi hidrogeokimia secara spasial dan temporal; dan (3) mengetahui proses yang dominan berpengaruh terhadap kondisi hidrogeokimia.

Data penelitian dikumpulkan selama satu tahun dari Maret 2018-Maret 2019. Dua buah *logger* dipasang di setiap lokasi untuk mencatat tinggi muka air (TMA) dengan interval 15 menit. Sebanyak 72 sampel air sepanjang tahun dikumpulkan dan dianalisis untuk menggambarkan karakter hidrokimia di tiga lokasi. Data TMA diolah menjadi hidrograf aliran untuk selanjutnya dihitung konstanta resesi *diffuse*, *fissure*, *conduit* serta persentase aliran dasar (PAD). Pengolahan data kimia meliputi penentuan tipe kimia, pembuatan kemograf, perhitungan SI kalsit dan log PCO₂. Sampel air dengan parameter hidrodinamika dan hidrogeokimia selanjutnya diolah dengan *Principal Component Analysis* (PCA) untuk menentukan proses yang dominan berpengaruh pada kondisi hidrogeokimia akuifer di setiap lokasi.

Hasil penelitian menunjukkan kondisi hidrodinamika dan hidrogeokimia yang bervariasi secara spasial dan temporal. Kondisi hidrodinamika ketiga lokasi dicirikan dengan tipe porositas aliran campuran, dengan pelepasan aliran *conduit* relatif cepat ($K_c \leq 0,5$), rekahan *fissure* yang berkembang ($K_i < 0,9$), dan pelepasan aliran *diffuse* yang lambat ($K_b \geq 0,99$). Rerata PAD bulanan cenderung tinggi (>85%) menunjukkan akuifer masih baik dalam menyimpan air. Kondisi hidrogeokimia menunjukkan variasi temporal yang dikontrol oleh kondisi hidrodinamika. Kandungan kimia cenderung tinggi ketika musim kemarau karena dominasi aliran lambat (*diffuse*), menyebabkan dominannya proses *water-rock interaction*. Kandungan kimia mengalami penurunan ketika musim penghujan seiring bertambahnya kontribusi aliran *conduit* dan *fissure*, menyebabkan dominannya proses *dilution by precipitation*. Ketiga lokasi dipengaruhi secara dominan oleh proses yang terjadi dalam akuifer, yakni *water-rock interaction* dan *dilution by precipitation*. Faktor yang berpengaruh lainnya berbeda di setiap lokasi bergantung pada karakteristik sekitar.

Kata Kunci: Hidrodinamika, Hidrogeokimia, *Principal Component Analysis*, Karakterisasi Akuifer, Karst Jonggrangan

**STUDY OF SPATIO - TEMPORAL HYDRODYNAMIC AND
HYDROGEOCHEMISTRY FOR AQUIFER CHARACTERIZATION IN
JONGGRANGAN KARST, KULON PROGO - PURWOREJO REGENCY**

(Case Study: Anjani, Kiskendo Underground River, and Mudal Spring)

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ABSTRACT

Anjani, Kiskendo Underground River, and Mudal Spring are part of Jonggrangan Karst that have important role for society around it. Aquifer characterization, especially the development of karstic network is needed to support water resource management. The objectives of this study were: (1) to identify spatio-temporal variation of hydrodynamical characteristic; (2) to identify spatio-temporal variation of hydrogeochemical characteristic; and (3) to determine the dominant process controlling groundwater hydrogeochemistry.

Data were obtained from March 2018 to March 2019. Two loggers were installed in each location to collect groundwater stage data within 15 minutes interval. 72 water samples were collected including sample from Kiskendo Cave, Mudal Spring, dan Anjani Cave in dry season, wet season, and flood event. Recession constant of diffuse, fissure, conduit flow and baseflow percentage were conducted from hydrograph. The chemical water type, chemograph, calcite saturation indices, and CO₂ partial pressure (log PCO₂) were calculated to conduct hydrogeochemical analysis. All water sample with variable of hydrodynamic and hydrogeochemistry parameter then turned into principal component analysis (PCA) to determine process that control the hydrogeochemistry of groundwater.

The results showed that hydrodynamical and hydrogeochemical condition of Jonggrangan Karst Area varied both spatially and temporally. The hydrodynamical condition of Kiskendo Cave, Mudal Spring, and Anjani Cave was characterized by mixing flow type, with fast conduit flow release ($K_c \leq 0,5$), developed fissure ($K_i < 0,9$), and slow release of diffuse flow ($K_b \geq 0,99$). Those conditions indicated that aquifer was developed but still good in storing groundwater. Groundwater chemistry varied temporally, which was high during dry season and low during wet season. High amount of chemical condition was caused by high proportion of slowflow (diffuse), indicating water-rock interaction as the main process, and low amount of chemical condition was caused by high proportion of fastflow from surface, causing the dilution by precipitation process that controlling aquifer hydrogeochemistry. PCA revealed that all location dominantly controlled by water-rock interaction and dilution by precipitation process. Other process that controlled hydrochemical of groundwater varied in all location depended on surrounding characteristic.

Keywords: *Hydrodynamic, Hydrogeochemistry, Principal Component Analysis, Aquifer Characterization, Jonggrangan Karst*