

## **Karakterisasi Akuifer Karst dengan Pendekatan Variasi Hidrogeokimia dan Pelepasan Aliran di Mataair Kalisirah dan Jumbleng, Karst Gombang Selatan**

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### **INTISARI**

Mataair Kalisirah dan Jumbleng merupakan mataair dengan debit terbesar di bagian dari Karst Gombang Selatan. Karakterisasi akuifer terkait perkembangan akuifer karst perlu dilakukan sebagai dasar pengelolaan sumberdaya air berkelanjutan, baik dari segi kuantitas maupun kualitas. Penelitian ini bertujuan untuk: (1) mengkaji kondisi pelepasan aliran secara spasial dan temporal; (2) mengkaji kondisi hidrogeokimia secara spasial dan temporal; dan (3) Mengkaji pengaruh variasi curah hujan dan variasi pelepasan aliran terhadap hidrogeokimia di Mataair Kalisirah dan Jumbleng.

Data penelitian dikumpulkan lebih dari satu tahun yakni November 2018-Maret 2020. Dua buah *logger* dipasang di setiap lokasi untuk mencatat tinggi muka air (TMA) dengan interval 15 menit. Sebanyak 46 sampel air sepanjang tahun dikumpulkan dan dianalisis untuk menggambarkan karakter hidrokimia di dua lokasi. Data TMA diolah menjadi hidrograf aliran untuk kemudian dihitung konstanta resesi *diffuse*, *fissure*, *conduit*, prosentase aliran dasar (PAD), rerata waktu  $T_p$  (waktu menuju puncak) dan rerata waktu  $T_b$  (waktu menuju aliran dasar). Pengolahan data kimia meliputi pembuatan kemograf, *scatter-plot* parameter kimia, perhitungan SI kalsit dan  $\log P_{CO_2}$ . Sampel air dengan parameter pelepasan aliran dan hidrogeokimia selanjutnya diolah dengan *Principal Component Analysis* (PCA) dan *scatter-plot* untuk menentukan proses yang dominan berpengaruh pada kondisi hidrogeokimia akuifer di setiap lokasi.

Hasil penelitian menunjukkan kondisi pelepasan aliran dan hidrogeokimia yang bervariasi secara spasial dan temporal. Kondisi pelepasan kedua lokasi dicirikan dengan tipe porositas aliran campuran, dengan pelepasan aliran *conduit* relatif cepat ( $K_c \leq 0,5$ ) di Mataair Kalisirah dan lambat ( $K_c > 0,5$ ) di Mataair Jumbleng, rekahan *fissure* yang berkembang ( $K_i < 0,9$ ), dan pelepasan aliran *diffuse* yang lambat ( $K_b \geq 0,99$ ) di kedua mataair. Rerata PAD bulanan cenderung tinggi (>80%) menunjukkan akuifer masih baik dalam menyimpan air. Kondisi hidrogeokimia menunjukkan variasi temporal yang dikontrol oleh kondisi pelepasan aliran. 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*. Kedua 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 lorong di dalam akuifer dan faktor permukaan.

**Kata Kunci:** Pelepasan aliran, Hidrogeokimia, *Principal Component Analysis*, Karakterisasi Akuifer, Karst Gombang

***Karst Aquifer Characterization Using Hydrogeochemical Variation and Flow Release Approach at Kalisirah and Jumbleng Springs, South Gombong Karst Area***

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**ABSTRACT**

*Kalisirah and Jumbleng springs are springs with the highest discharge in the South Gombong Karst Area. Aquifer characterization, especially the development of karst aquifers has to be done as a basis for sustainable water resource management, both in terms of quantity and quality. This study aims to: (1) identify the conditions of spatial and temporal flow release; (2) assessing the hydrogeochemical conditions spatially and temporally; and (3) identify the processes of rainfall and hidrodinamic condition that affect the hydrogeochemical conditions.*

*Data were obtained over one year, from November 2018 until March 2020. Two loggers were installed at each location to record the water level at 15-minute intervals. A total of 46 water samples were collected and analyzed to describe the two locations' hydrochemical characteristics. Recession constant of diffuse, fissure, conduit, percentage of baseflow,  $T_p$  (time to peak), and  $T_b$  (time to base flow) were conducted from hydrograph. Chemographs, scatter-plots, SI calcite, and  $CO_2$  partial pressure ( $\log P_{CO_2}$ ) were calculated to conduct hydrochemical analysis. All water samples with variable flow release and hydrogeochemical parameters were processed by Principal Component Analysis (PCA) and scatter-plot to determine the process that affects the aquifer's hydrogeochemical conditions for each location.*

*The results showed that flow release and hydrogeochemical condition of Kalisirah and Jumbleng springs varied both spatially and temporally. Flow release condition of Kalisirah and Jumbleng springs was characterized by mixing flow type, with fast conduit flow release ( $K_c \leq 0,5$ ) at Kalisirah Springs and low conduit flow release ( $K_c > 0,5$ ) at Jumbleng Springs, developed fissure ( $K_i < 0,9$ ), and slow release of diffuse flow ( $K_b \geq 0,99$ ) at two Springs. Those conditions indicated that the aquifer was developed but still useful in storing groundwater. Groundwater chemistry varied temporally, which was high during the dry season and low during the wet season. A high amount of chemical condition was caused by a high proportion of slow flow (diffuse), indicating water-rock interaction as the primary process. A low amount of chemical condition was caused by the high proportion of quick flow from surface, causing the dilution precipitation process that controlling aquifer hydrogeochemistry. PCA revealed that all locations are dominantly controlled by water-rock interaction and dilution by precipitation process. Another process that controlled the hydrochemical of groundwater varied in all locations depended on aquifer and surface factors.*

**Keywords:** *Flow release, Hydrogeochemistry, Principal Component Analysis, Aquifer Characterization, Karst Gombong*