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Karst springs in small islands: The Kamari spring (Mylopotamos) in Kythira Island, Greece

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Geological setting

Consolidation and classification of Kythira geological formations (Geological mapping from Danamos, 1992)

Quaternary
- Alluvial deposits and eluvial mantle
- Screes

Neogene
- Conglomerates, marly limestones and sandstones
- Marls and sands

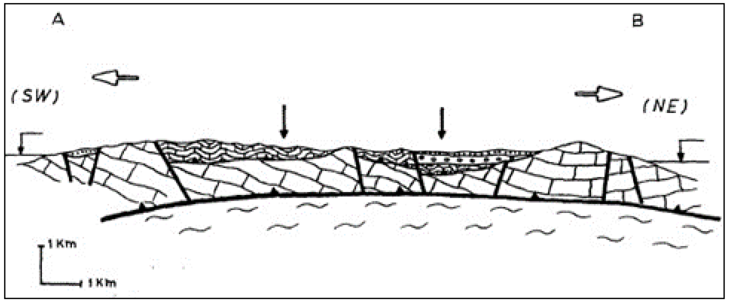
Pindos unit
- Flysch
- Carbonate formations
- Clastic formations

Tripolis unit
- Flysch
- Carbonate formations
- Tyros beds

Phyllites - Quartzites
- Phyllites - Quartzites

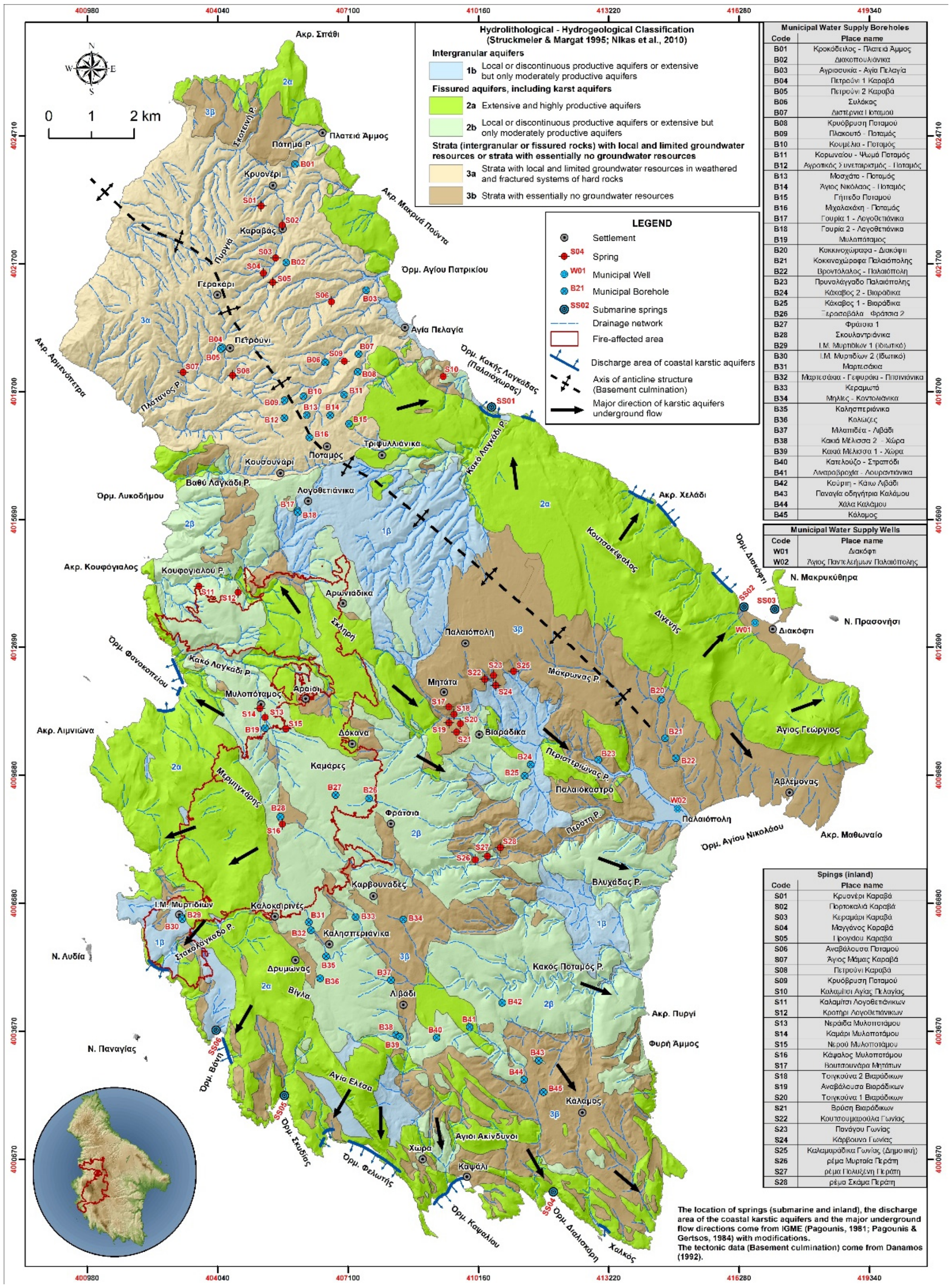
- Overthrust
- Thrust
- Fault

LEGEND
- Settlement
- S04 Spring
- W01 Municipal Well (2)
- B21 Municipal Borehole (46)
- SS02 Submarine springs
- Drainage network
- Fire-affected area
- Discharge area of coastal karstic aquifers
- Axis of anticline structure (Basement culmination)
- Major direction of karstic aquifers underground flow



The location of springs (submarine and inland), the discharge area of the coastal karstic aquifers and the major underground flow directions come from IGME (Pagounis, 1981; Pagounis & Gertsos, 1984; Danamos, 1992; Koumantakis et al., 2006) with modifications.
The tectonic data (Basement culmination) come from Danamos (1992).

Hydrolithological – Hydrogeological setting



Municipal Water Supply Boreholes	
Code	Place name
B01	Κροκόδειλος - Πλατειά Άμμος
B02	Διακοπουλιάνικα
B03	Αγριοσυκιά - Αγία Πελαγία
B04	Πετρούνι 1 Καραβά
B05	Πετρούνι 2 Καραβά
B06	Συλάκας
B07	Διστέρνια Ποταμού
B08	Κρυόβρυση Ποταμού
B09	Πλακουτό - Ποταμός
B10	Κουμέλια - Ποταμός
B11	Κορωναίου - Ψωμά Ποταμός
B12	Αγροτικός Συνεταιρισμός - Ποταμός
B13	Μοσχάτο - Ποταμός
B14	Άγιος Νικόλαος - Ποταμός
B15	Γήπεδο Ποταμού
B16	Μιχαλακάκη - Ποταμός
B17	Γουρία 1 - Λογοθετιάνικα
B18	Γουρία 2 - Λογοθετιάνικα
B19	Μυλοπόταμος
B20	Κοκκινοχώραφα - Διακόφτι
B21	Κοκκινοχώραφα Παλαιόπολης
B22	Βροντόλαλος - Παλαιόπολη
B23	Πρυνολάγγαδο Παλαιόπολης
B24	Κάκαβος 2 - Βιαράδικα
B25	Κάκαβος 1 - Βιαράδικα
B26	Ξεροσαβάλα - Φράτσια 2
B27	Φράτσια 1
B28	Σκουλαντριάνικα
B29	Ι.Μ. Μυρτιδίων 1 (Ιδιωτικό)
B30	Ι.Μ. Μυρτιδίων 2 (Ιδιωτικό)
B31	Μαρτεσάκια
B32	Μαρτεσάκια - Γεφυράκι - Πιτσινιάνικα
B33	Κεραμωτό
B34	Μηλιές - Κοντολιάνικα
B35	Καλησπεριάνικα
B36	Καλώζες
B37	Μλαπιδέα - Λιβάδι
B38	Κακιά Μέλισσα 2 - Χώρα
B39	Κακιά Μέλισσα 1 - Χώρα
B40	Κατελούζο - Στραπόδι
B41	Αναραβροχιά - Λουραντιάνικα
B42	Κούριτ - Κάτω Λιβάδι
B43	Παναγία οδηγήτρια Καλάμου
B44	Χάλα Καλάμου
B45	Κάλαμος

Municipal Water Supply Wells	
Code	Place name
W01	Διακόφτι
W02	Άγιος Παντελεήμων Παλαιόπολης

Spings (inland)	
Code	Place name
S01	Κρυονέρι Καραβά
S02	Πορτοκαλιά Καραβά
S03	Κεραμάρι Καραβά
S04	Μαγγάνος Καραβά
S05	Προγκίου Καραβά
S06	Αναβάλουσα Ποταμού
S07	Άγιος Μάμας Καραβά
S08	Πετρούνι Καραβά
S09	Κρυόβρυση Ποταμού
S10	Καλαμίτσι Αγίας Πελαγίας
S11	Καλαμίτσι Λογοθετιάνικων
S12	Κρατήρι Λογοθετιάνικων
S13	Νεράιδα Μυλοποτάμου
S14	Καμάρι Μυλοποτάμου
S15	Νερού Μυλοποτάμου
S16	Κάψαλος Μυλοποτάμου
S17	Βουτσουνάρα Μητάτων
S18	Τσιγκούνα 2 Βιαράδικων
S19	Αναβάλουσα Βιαράδικων
S20	Τσιγκούνα 1 Βιαράδικων
S21	Βρύση Βιαράδικων
S22	Κουτσουμαρούλα Γωνιάς
S23	Πανάγου Γωνιάς
S24	Κάρβουνα Γωνιάς
S25	Καλαμαράδικα Γωνιάς (Δημοτική)
S26	ρέμα Μυρταία Περάτη
S27	ρέμα Πολυξένη Περάτη
S28	ρέμα Σκάμα Περάτη

Hydrolithological - Hydrogeological Classification (Struckmeier & Margat 1995; Nikas et al., 2010)

Intergranular aquifers

- **1b** Local or discontinuous productive aquifers or extensive but only moderately productive aquifers

Fissured aquifers, including karst aquifers

- **2a** Extensive and highly productive aquifers
- **2b** Local or discontinuous productive aquifers or extensive but only moderately productive aquifers

Strata (intergranular or fissured rocks) with local and limited groundwater resources or strata with essentially no groundwater resources

- **3a** Strata with local and limited groundwater resources in weathered and fractured systems of hard rocks
- **3b** Strata with essentially no groundwater resources

- **1b** Local or discontinuous productive aquifers or extensive but only moderately productive aquifers
- Alluvial deposits and eluvial mantle
- Screes
- Conglomerates, marly limestones and sandstones
- **2a** Extensive and highly productive aquifers
- Tripolis unit carbonate formations
- **2b** Local or discontinuous productive aquifers or extensive but only moderately productive aquifers
- Pindos unit carbonate formations
- **3a** Strata with local and limited groundwater resources in weathered and fractured systems of hard rocks
- Phyllites - Quartzites
- **3b** Strata with essentially no groundwater resources
- Marls and sands
- Pindos unit flysch
- Pindos unit clastic formations
- Tripolis unit flysch
- Tyros beds

LEGEND

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Three main aquifer systems developed on Kythira Island (Greece) include (Pagounis, 1981; Pagounis & Gertsos, 1984, Danamos, 1992; Koumantakis *et al.*, 2006; Filis *et al.*, 2019):

- The **porous aquifer system** in Neogene and Quaternary formations.
- The **karst aquifer system** in the carbonate formations of the Pindos and Tripolis Units.
- The **aquifer system** (both shallow and deep) in the **fractured hard rocks** mainly of the Phyllites – Quartzites Unit.

The **main discharge of the aquifer systems takes place in coastal and submarine brackish springs around the island**, except for its northern part where the Phyllites – Quartzites Unit outcrops and its **central part where springs of small capacity discharge the carbonate formations of the Pindos Unit**.

Precipitation is the direct recharge of the three aforementioned aquifer systems while **indirectly lateral discharge** occurs in places between **adjacent and tangential aquifer systems** and from the **streams runoff** as well.

Mylopotamos village – “Neraida or Fonissa waterfall”

In the area of **Mylopotamos village four springs discharge the karst aquifer of the Pindos Unit** within the channel of Kako Laghadi stream forming downstream the known **“Neraida or Fonissa waterfall”**. Moreover, along the dell of Kako Laghadi stream 22 watermills were built, among the plane trees and the ivy.

The Kamari spring – Hydrogeological setting

The **most significant** of the aforementioned springs is the **Kamari spring (+282.28 meters a.s.l.)** which emerge at the thrust fault between the overlying permeable carbonates and the underlying impermeable flysch formation of the Pindos Unit.

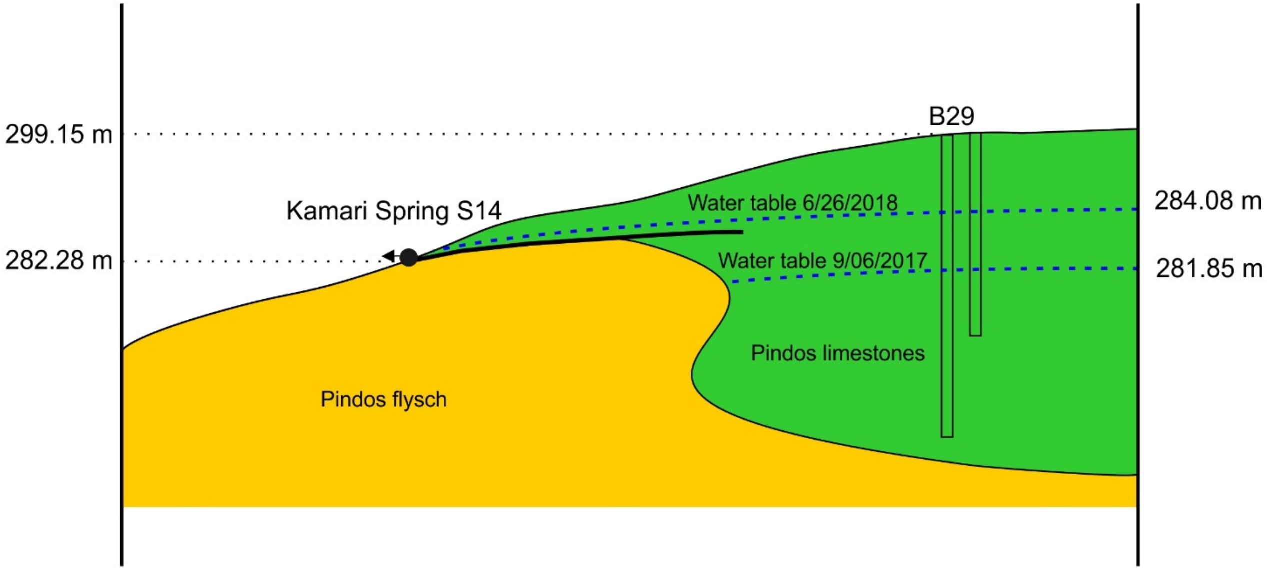
The **discharge of the Kamari spring** presents annual fluctuation which varies from app. **45-50 m³/h** (during winter) to **total recession** (during summer), due to **restriction of the precipitation** and the prolonged drought and **overpumping of its recharge area** mainly with boreholes.

The **inactive municipal borehole of Mylopotamos village (+299.15 meters a.s.l.) is located app. 310 meters SSE of the Kamari spring within its recharge area** (karst aquifer of the Pindos Unit). This borehole of a total depth of 40 meters penetrates carbonates of the Pindos Unit which thickness exceeds 100 meters in that area.

Monthly measurements of the Kamari spring discharge and the water table head in the inactive borehole demonstrate clear and direct hydraulic correlation between them.

The **Kamari spring presents outflow only in the case when the water level head of the borehole exceeds +282.28 meters**. This means that the **water level head in the borehole should not exceed 16.87 meters from the earth surface**. Taking into account all the aforementioned, the **Kamari spring** is designated as an **overflow spring**.

Finally, **microbiological analysis from the Kamari spring** showed **qualitative degradation**, due to **human activities** in the wider area (Pagounis, 1981; Filis *et al.*, 2019).



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