# Key shaping factors of anammox geographical distribution and function in riverine ecosystems

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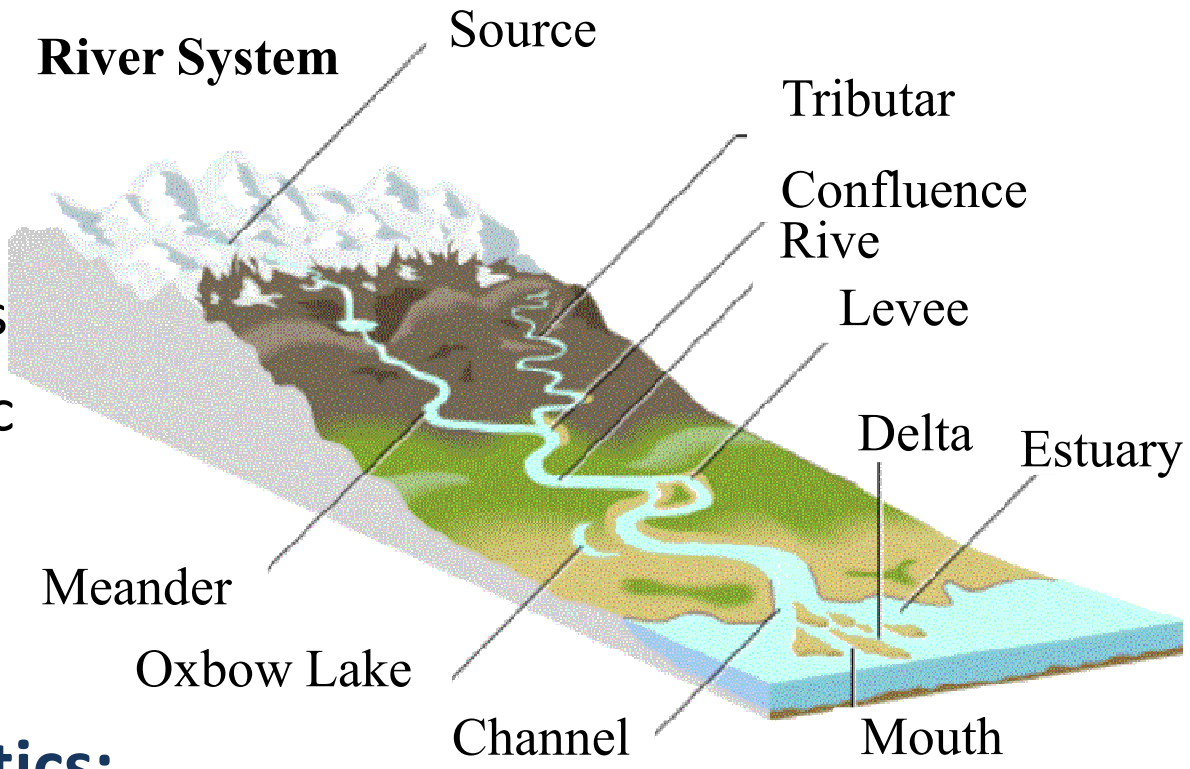
# Background

## River system

- Rivers link terrestrial and marine biospheres by transporting organic material and nutrients from land to ocean.

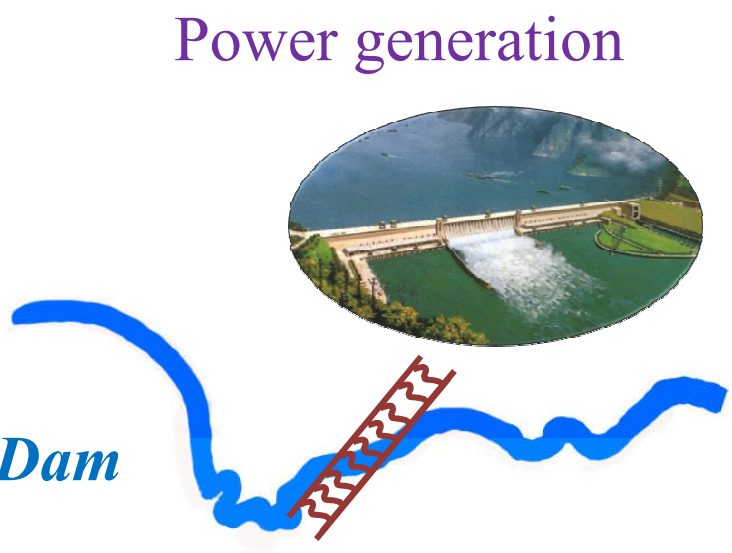



## River Characteristics:

- Large rivers flow through various landform types, different soil hydraulic and physicochemical properties, and different intensities of human alteration.

# Background

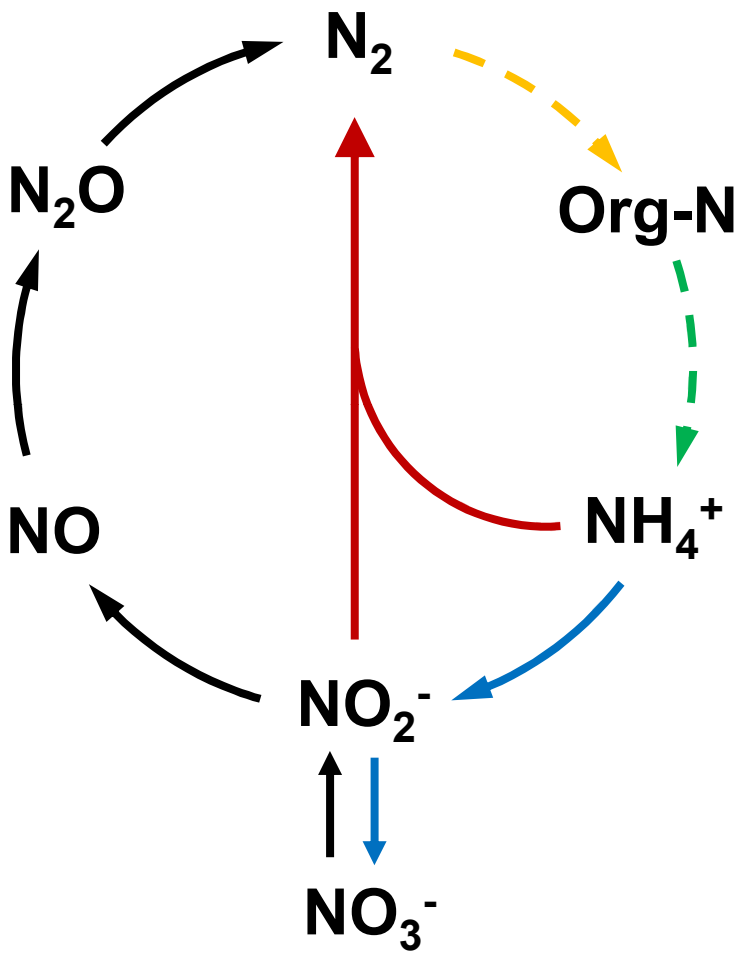
- Discrepant landform result in different delivery of resources to microbial active zones.
- Discrepant sediment affect nutrients concentration and sediment grain size.
- Dams alter upstream and downstream physicochemical and biological properties.



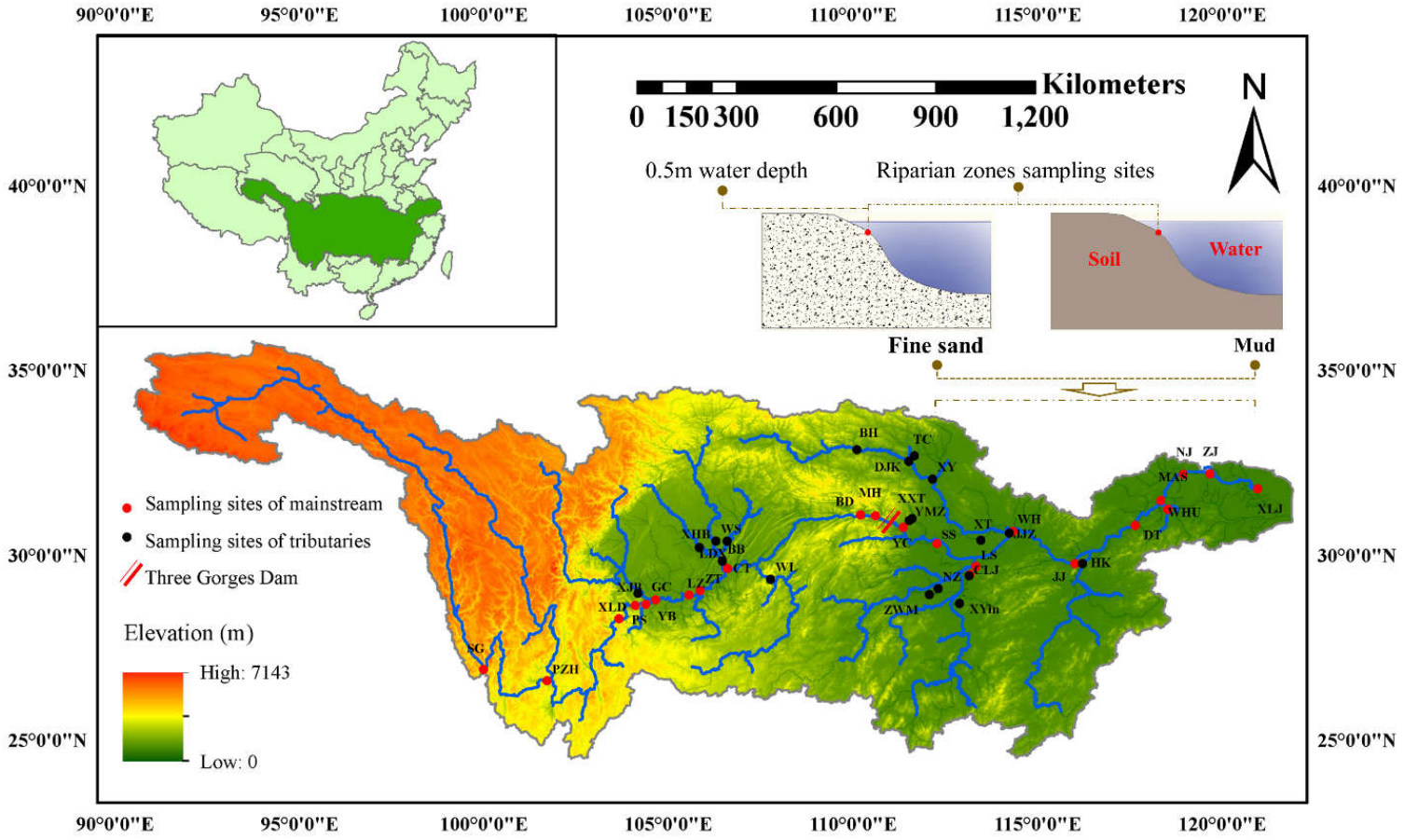

**Species evolution and geological change attributed to natural and anthropogenic impacts from the huge river system is necessary.**

# Background

- Anammox: ammonium conversion with nitrite to nitrogen gas.
- Crucial role and special pathway in nitrogen cycle in freshwater ecosystem.
- Has been found in many marine ecosystems at different scales.
- Lack of knowledge about anammox concerning the spatial patterning and geographic space along basin-scale river networks.

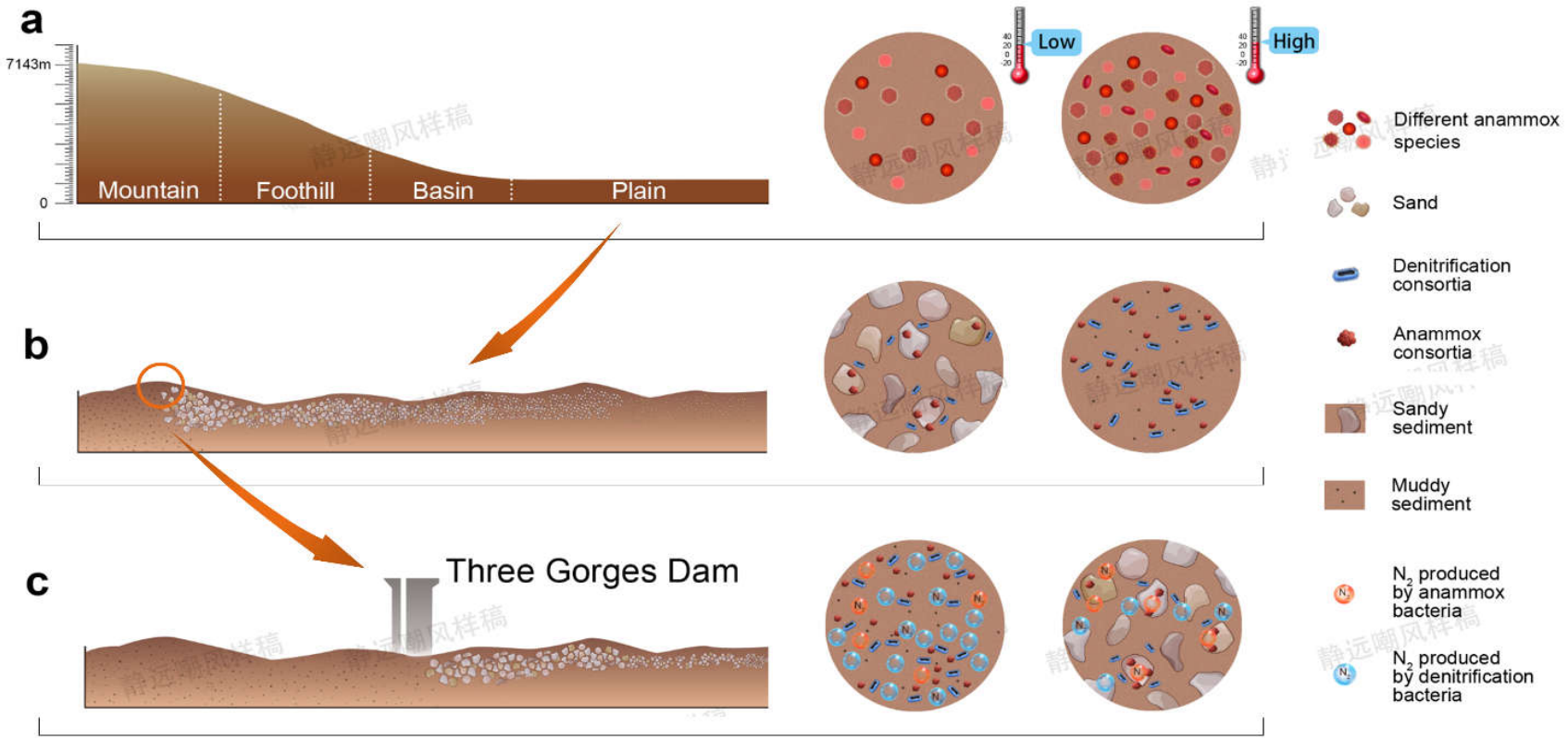


# Study area and methods




Forty-two sampling sites in the Yangtze River (4300 km) were totally chosen including twenty-three sites on the main stream and nineteen sites on the tributaries.

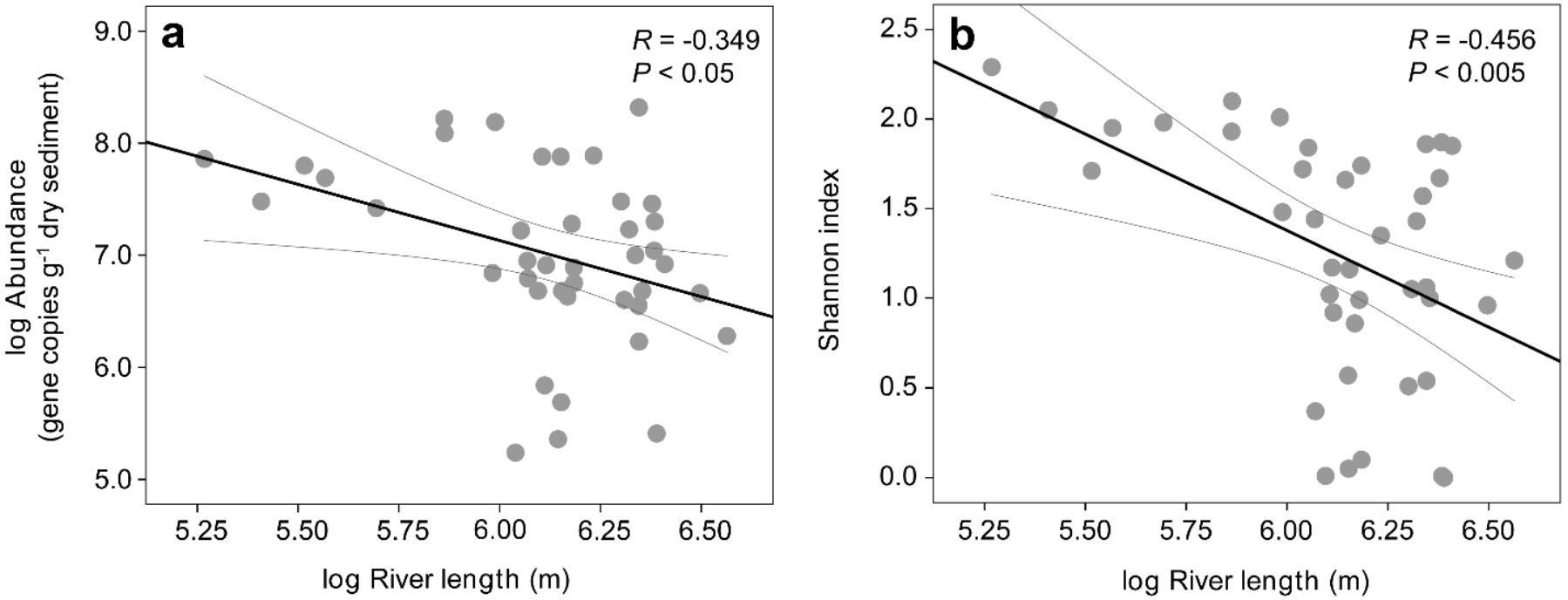
# Study area and methods




Try to find the profile of anammox distribution and activity shaping by landform types, sedimentary types and dams.

# I. Spatial analysis of anammox

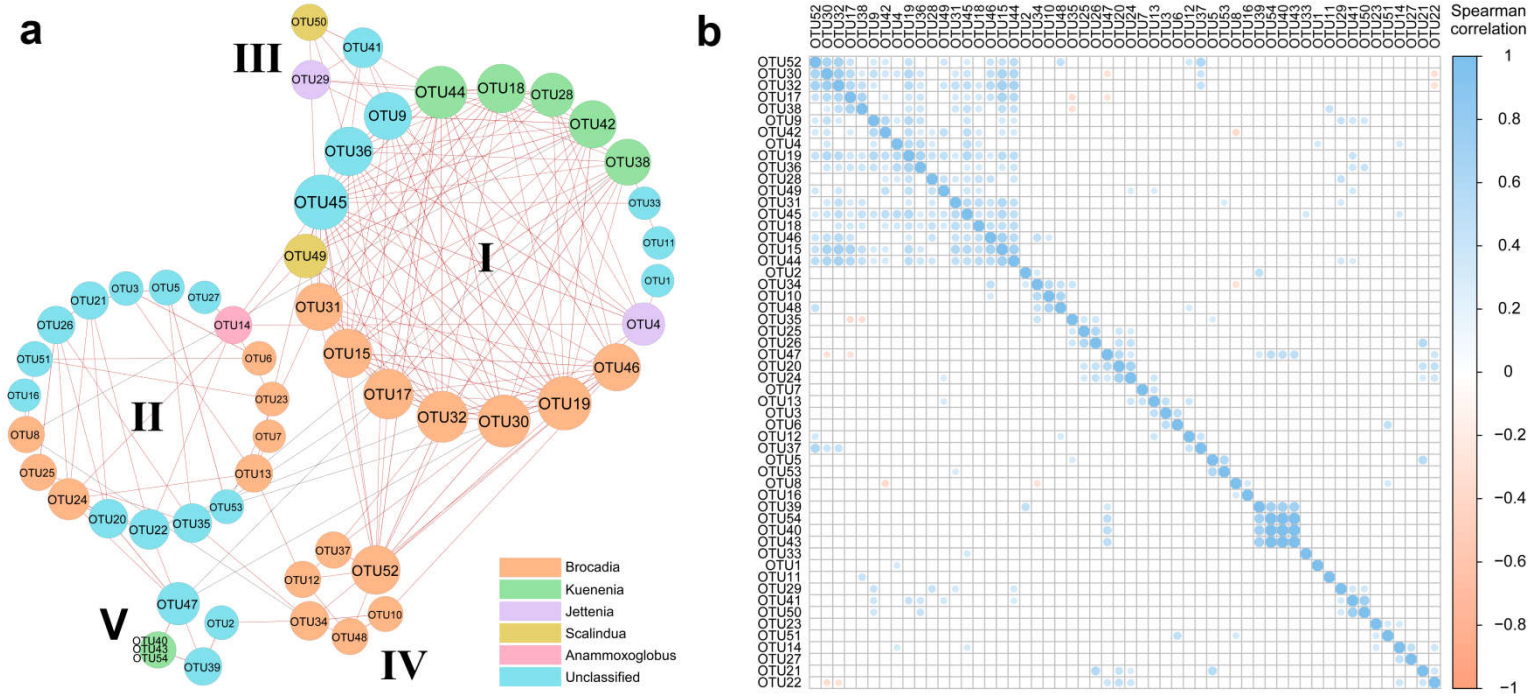
## 1. Spatial analysis of anammox bacterial abundance and diversity




- Anammox abundance and alpha diversity (Shannon index) were gradually increased downstream as confirmed by regression analysis using (log) “river length (distance to river mouth)”.

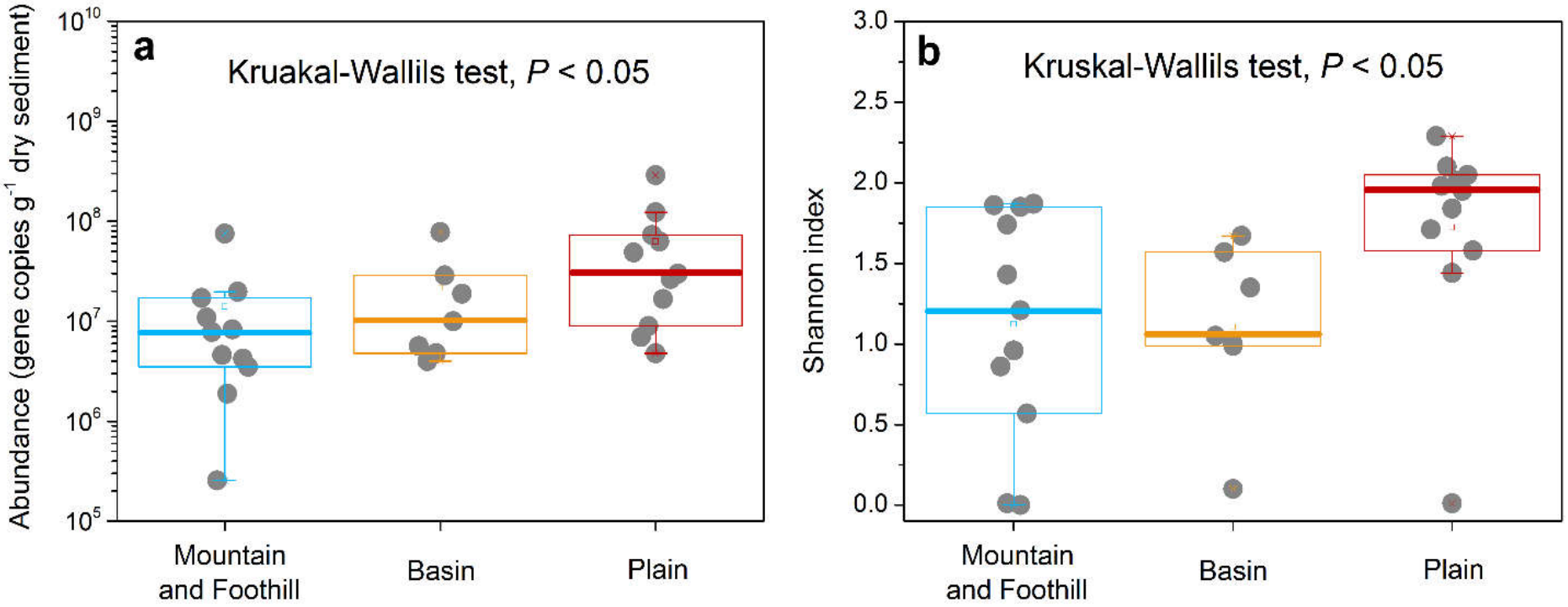
# I. Spatial analysis of anammox

## 2. Phylogenetic molecular ecology networks analysis of detected genera



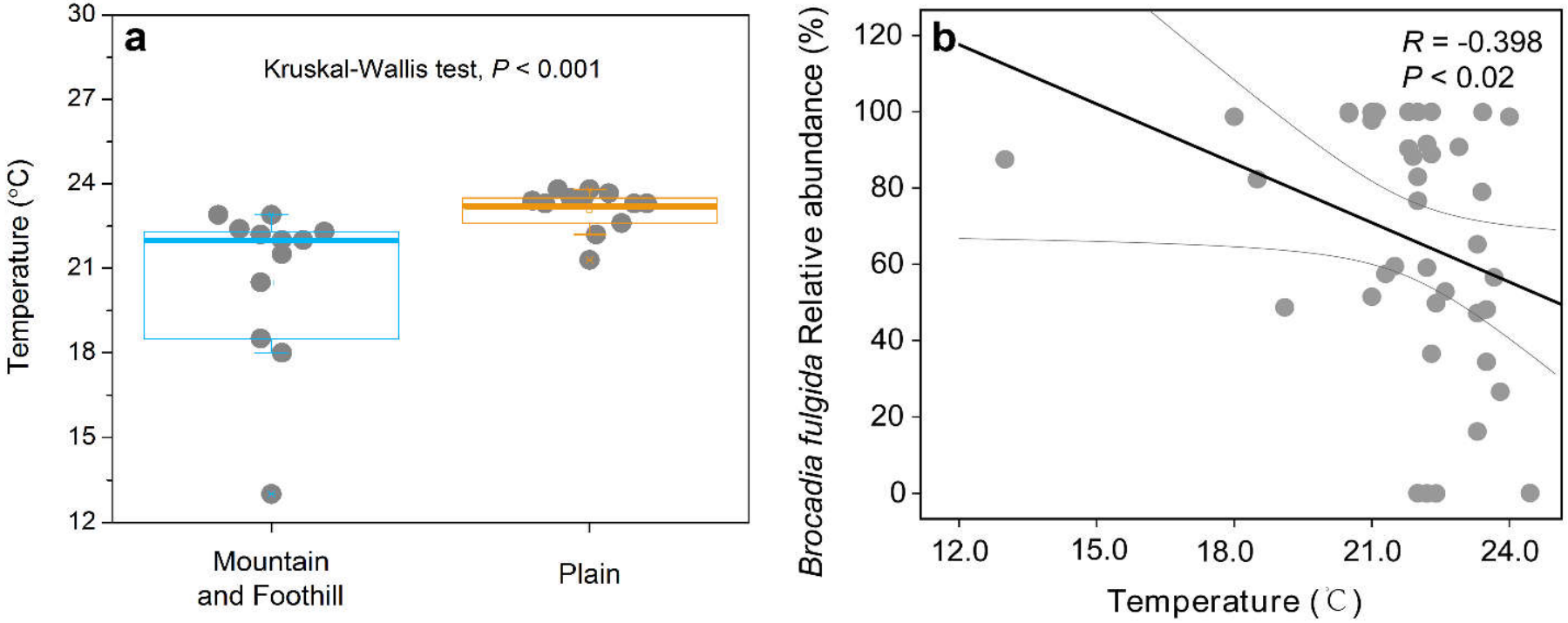

- The majority of the nodes belonged to *Brocadia* genus as they spread broadly in the major modules, and node with high degree, indicating they tend to share similar niche efficiently .

# *II. Anammox bacterial abundance and diversity responses to landform types*



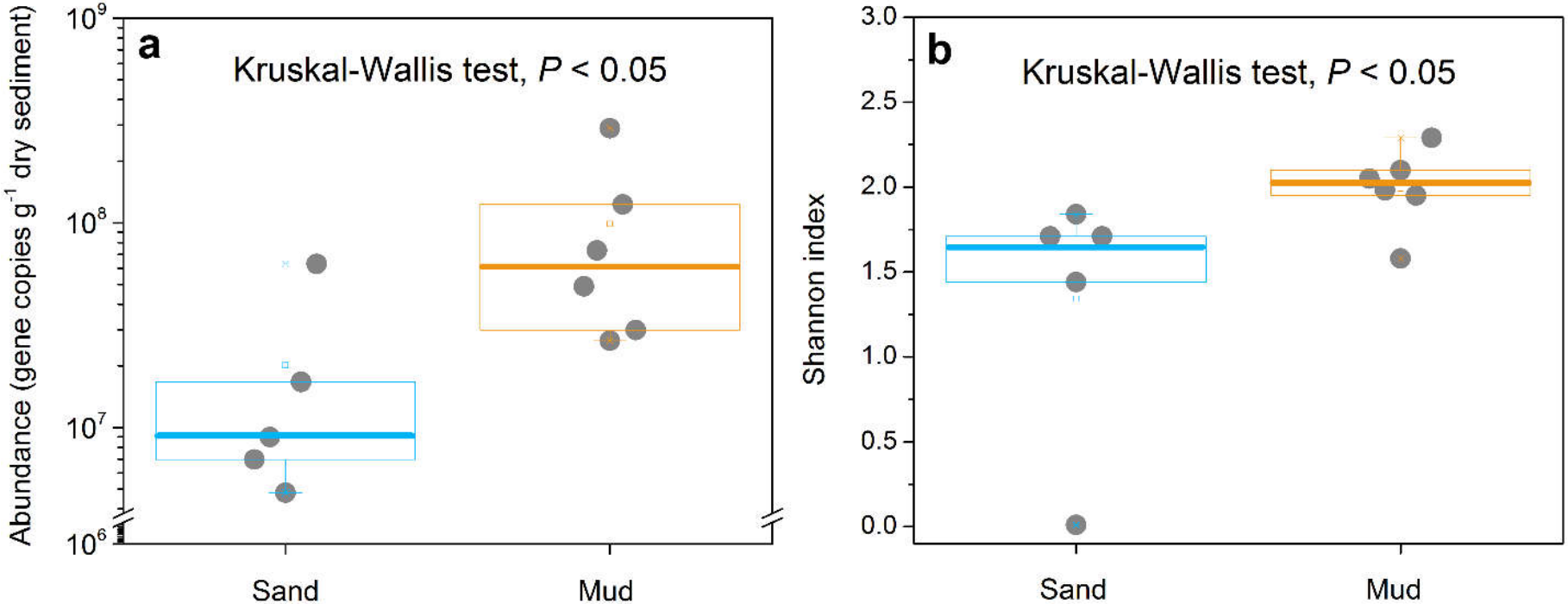

- Landform type could shape anammox bacterial abundance and diversity along large rivers.
- Plain area harbored higher anammox abundance and alpha diversity than that of mountain/foothill area.

# *II. Temperature shaping anammox in different landforms*



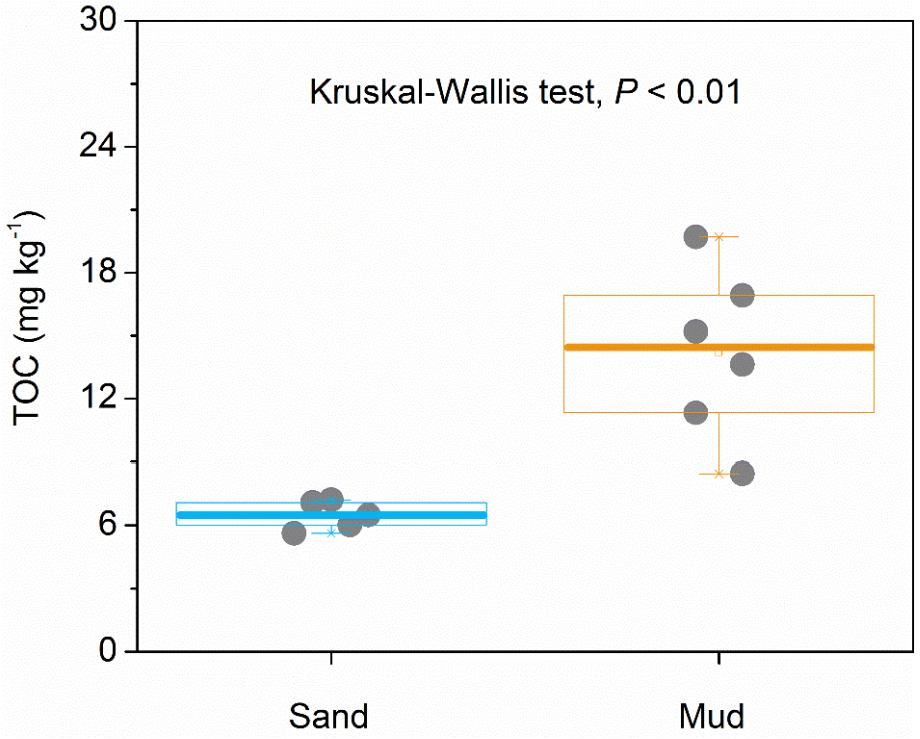

- Increasing temperature down river is highly correlated with anammox bacterial abundance and diversity, rather than other environmental factors.
- *Brocadia fulgida* as ‘cold tolerant’ anammox species.

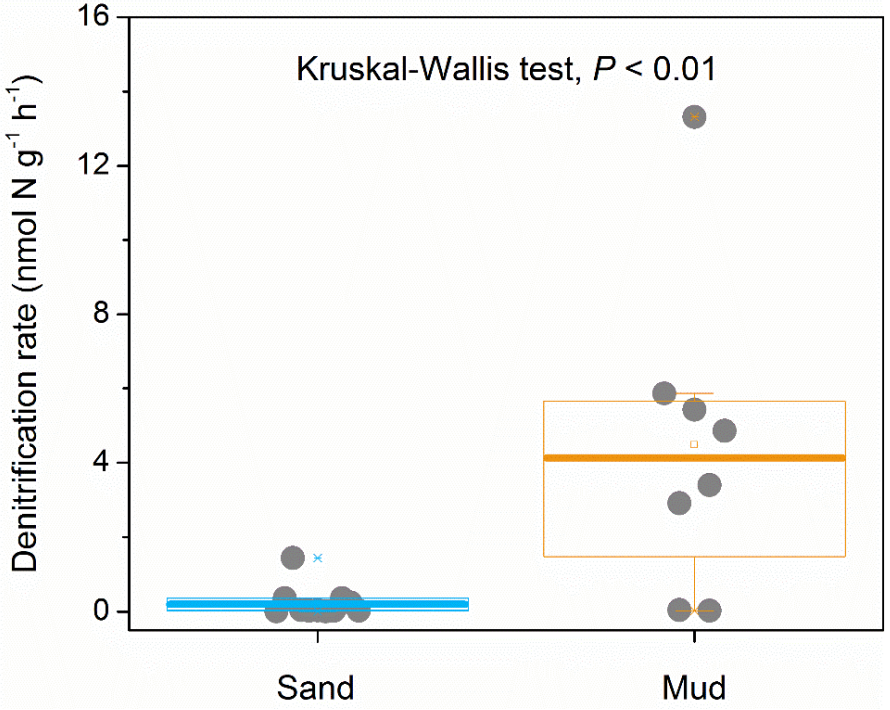
# *III. Anammox bacterial abundance and diversity responses to sediment types*




- Plain samples were further classified into subtype sandy sediment and muddy sediment.
- Muddy sediments harbored higher anammox bacterial abundance and diversity than that of sandy sediments in plain area.

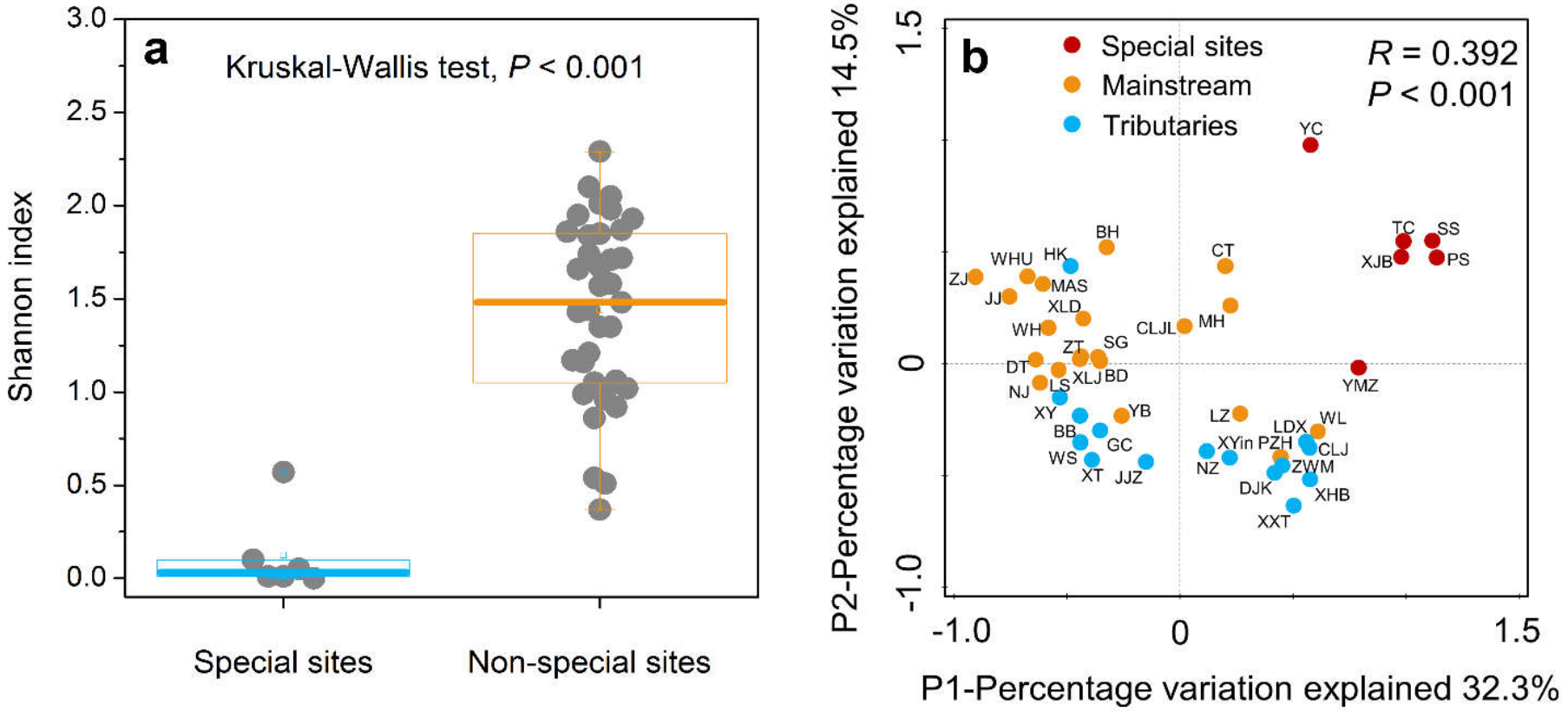
# *III. Permeability and nutriment determining anammox in different sediment types*



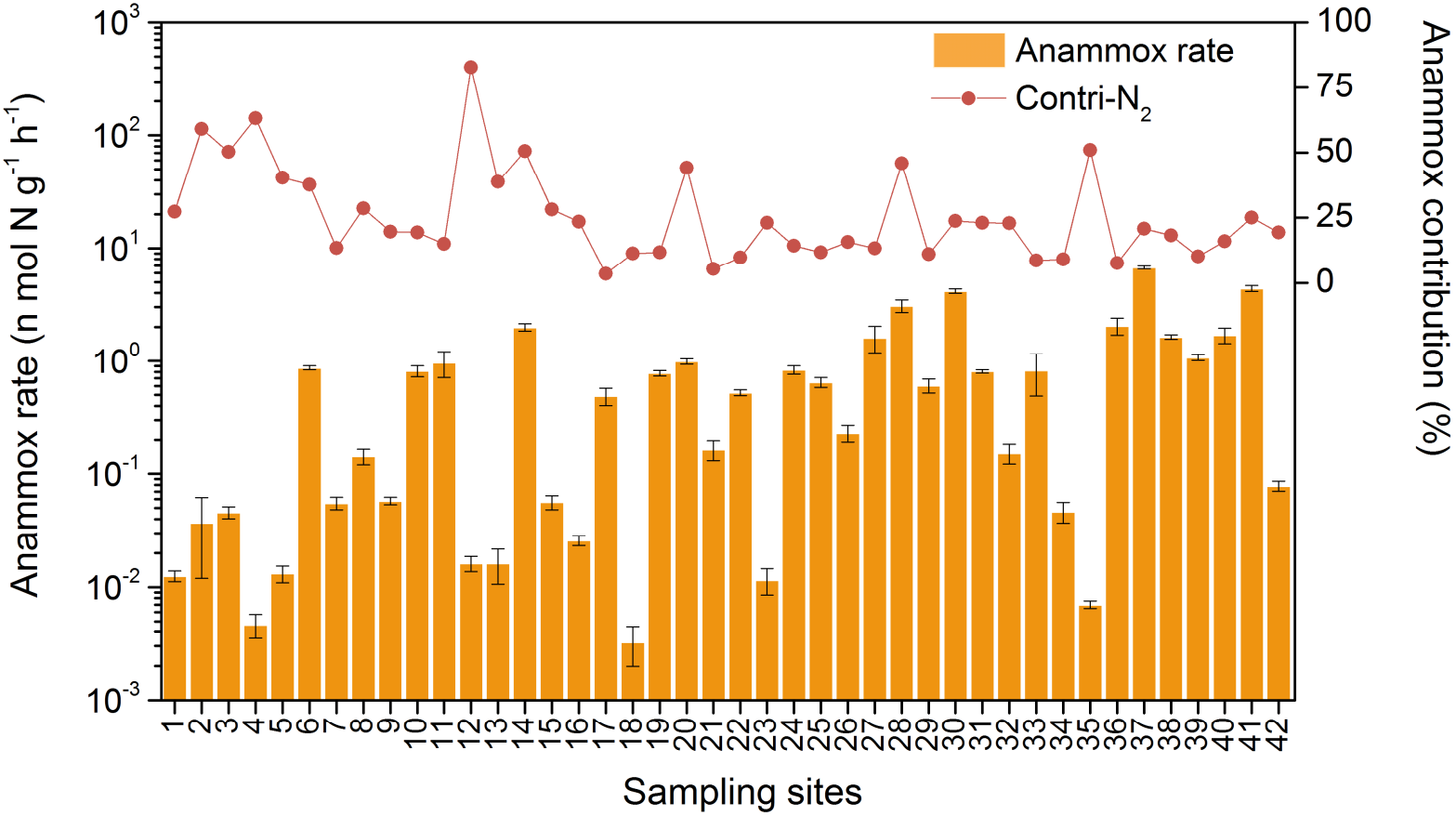

- Sediment permeability plays important role in determining the multi-anammox species survival.
- The higher TOC in muddy sediments enhanced denitrification process, which produced nitrite substrate for anammox bacteria.

# *IV. Dams impacts*



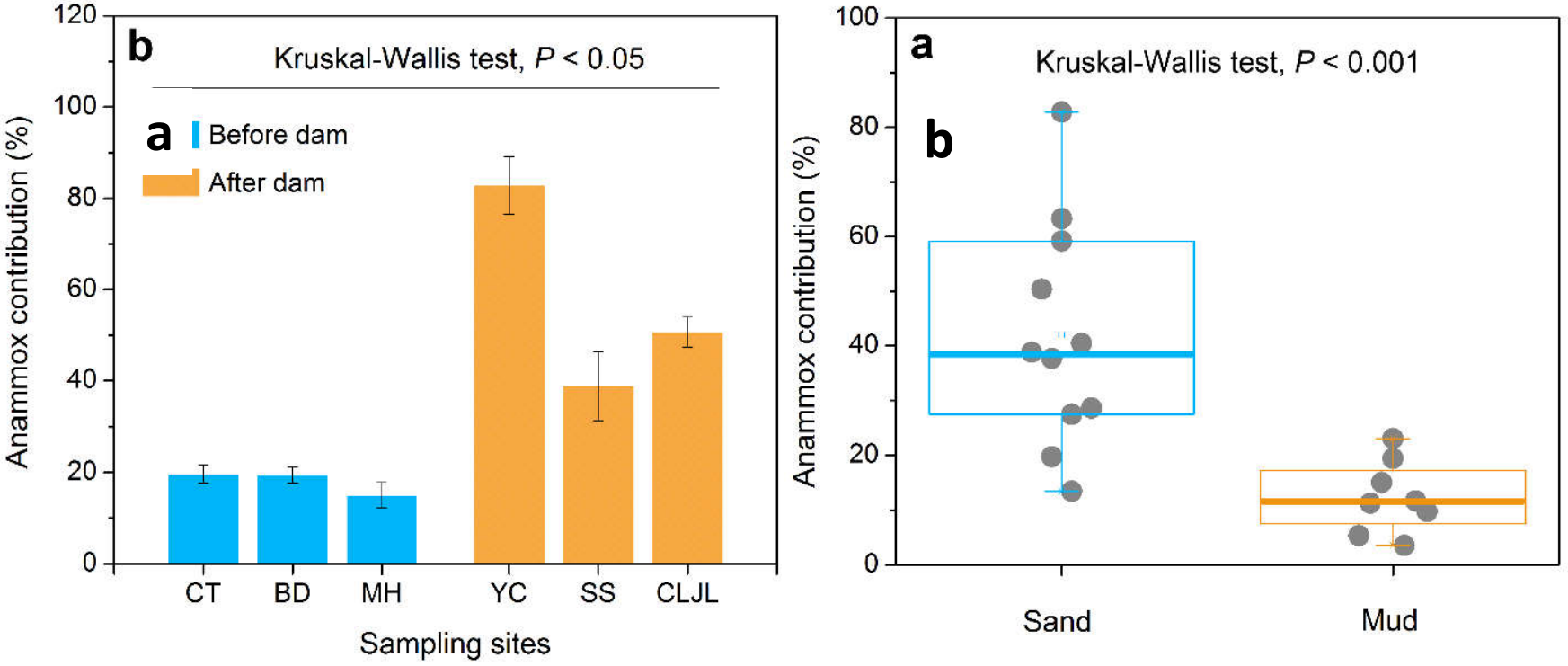

- Low alpha diversity was observed in the special sites with dams downwards.
- Serious sediment coarsening was confirmed downstream the dams, alters the sediment types.

# *VI. Contribution of anammox to nitrogen loss in the Yangtze River*




- Although the geographical factors are found to well shape the anammox bacterial abundance and diversity, we did not found the significant relations of these factors with anammox activity.

# *VI. Nutriment and hydraulic erosion by TGD dam judging anammox ra (contribution)*

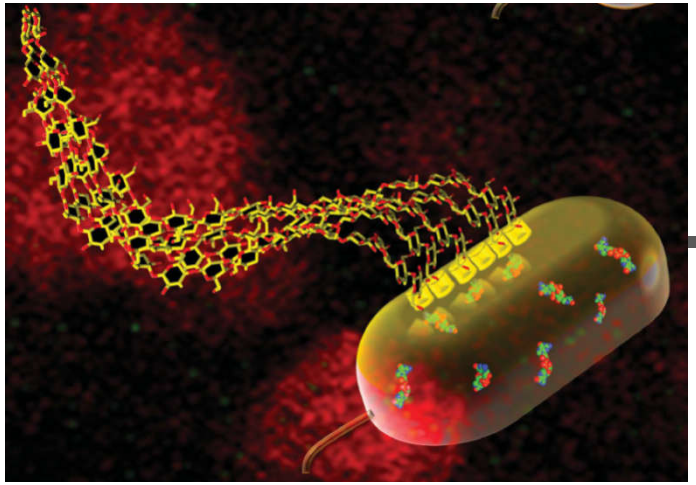



- Constant sediment scouring and erosion caused by damming would impact sediment types.
- Remarkable increase of ammonium concentration after the Three Gorges Dam, further contribute to the decreased ra.

# *VII. Significance and outlook*

- ***This study provides a robust analysis of the intrinsic causes determining anammox abundance, diversity and activity, underlying the critical roles of temperature, sediment permeability and riverbed coarsening in anammox bacterial niche besides nutriment supplement.***

- ***Anammox roles in nitrogen loss was influenced by damming, which may also implied the decreased N-related greenhouse gas emission in the riverine as the increased anammox.***



# Thank you!