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The State of the Art and Science of Coastal Engineering

Sediment dynamics behavior and beach profile types based on sediment properties

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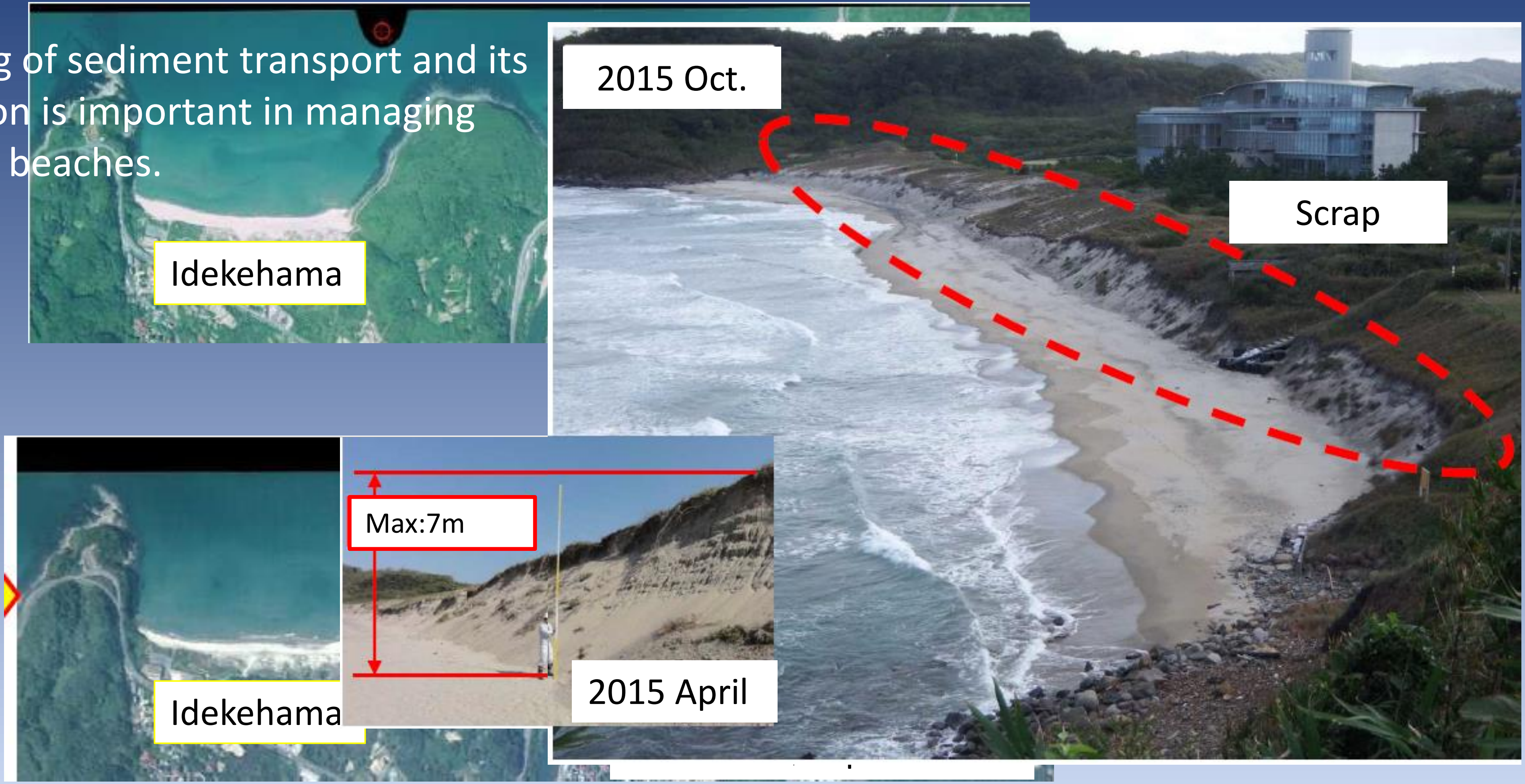
Contents

Background & Objective

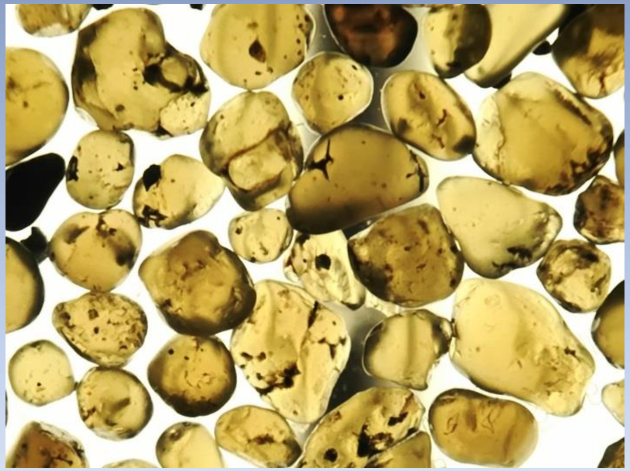
An understanding of sediment transport and its distribution is important in managing the sandy beaches.



Background & Objective

Sediments include the past history, and will give much information such as the direction of sediment transport or sediment transport behaviors

Main properties
Grain size, sorting, skewness and roundness ,



Background & Objective

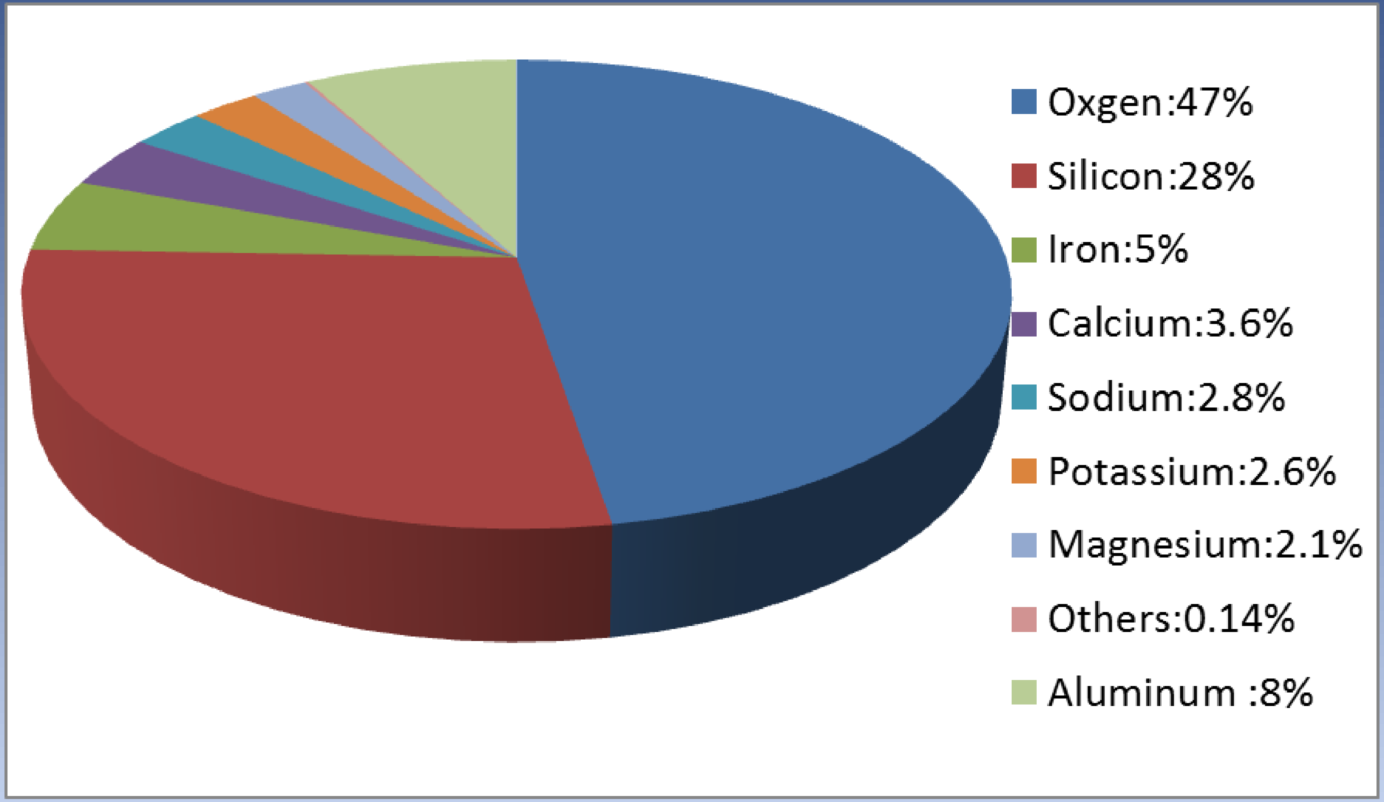
Another property:
Sediment composition compont
Iron, Debris of Coral, Foraminifera and Shellfish

Background & Objective

Another property:
Sediment Color

Background & Objective

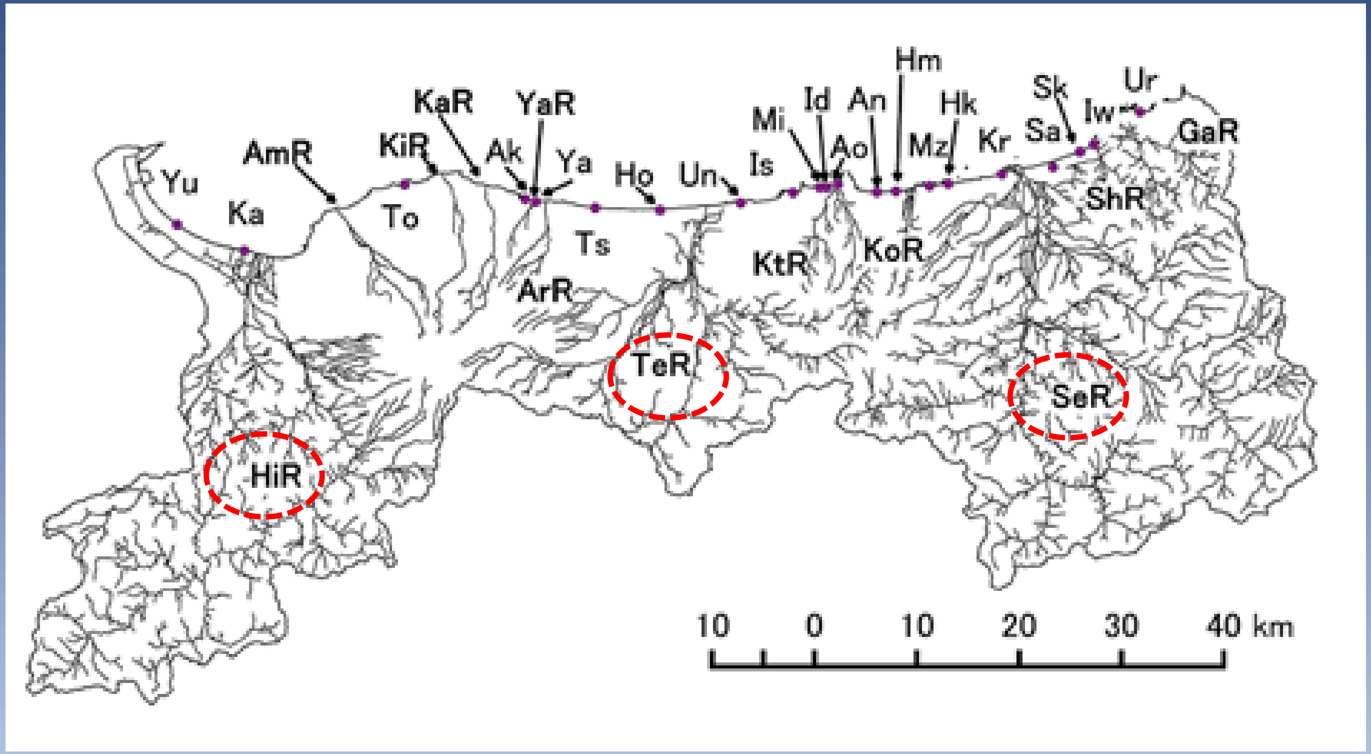
Main elements found in earth's crust



Another property
Geochemical elements

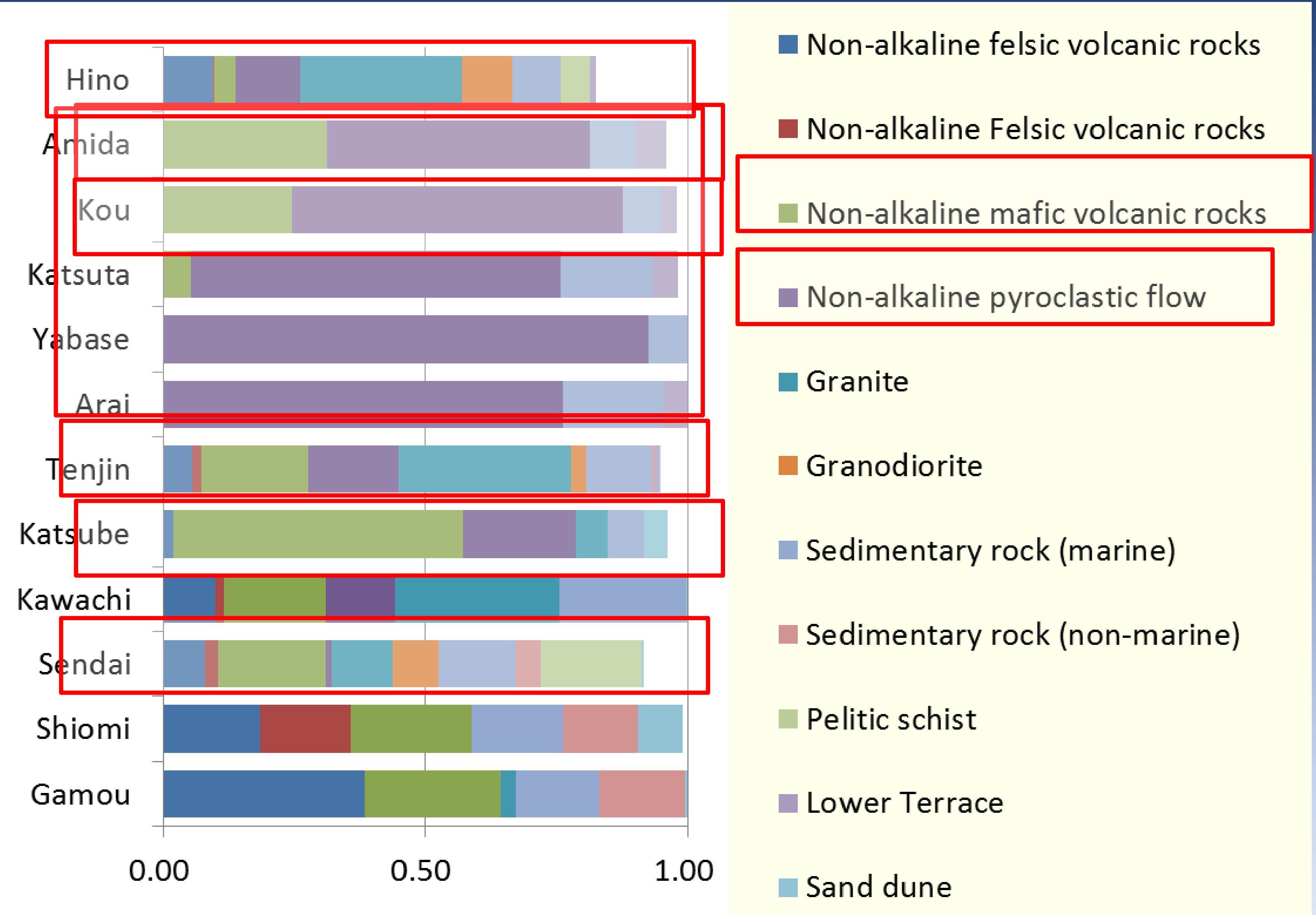
Extract new relationship among sediment transport and sediment properties

Sampling Sites

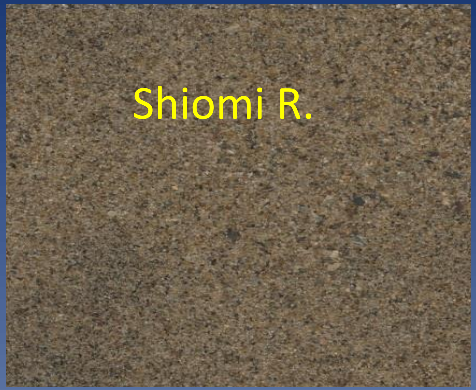


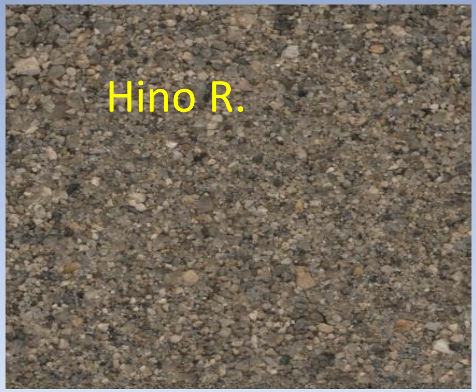
Beach : 21 samples
River : 12 samples

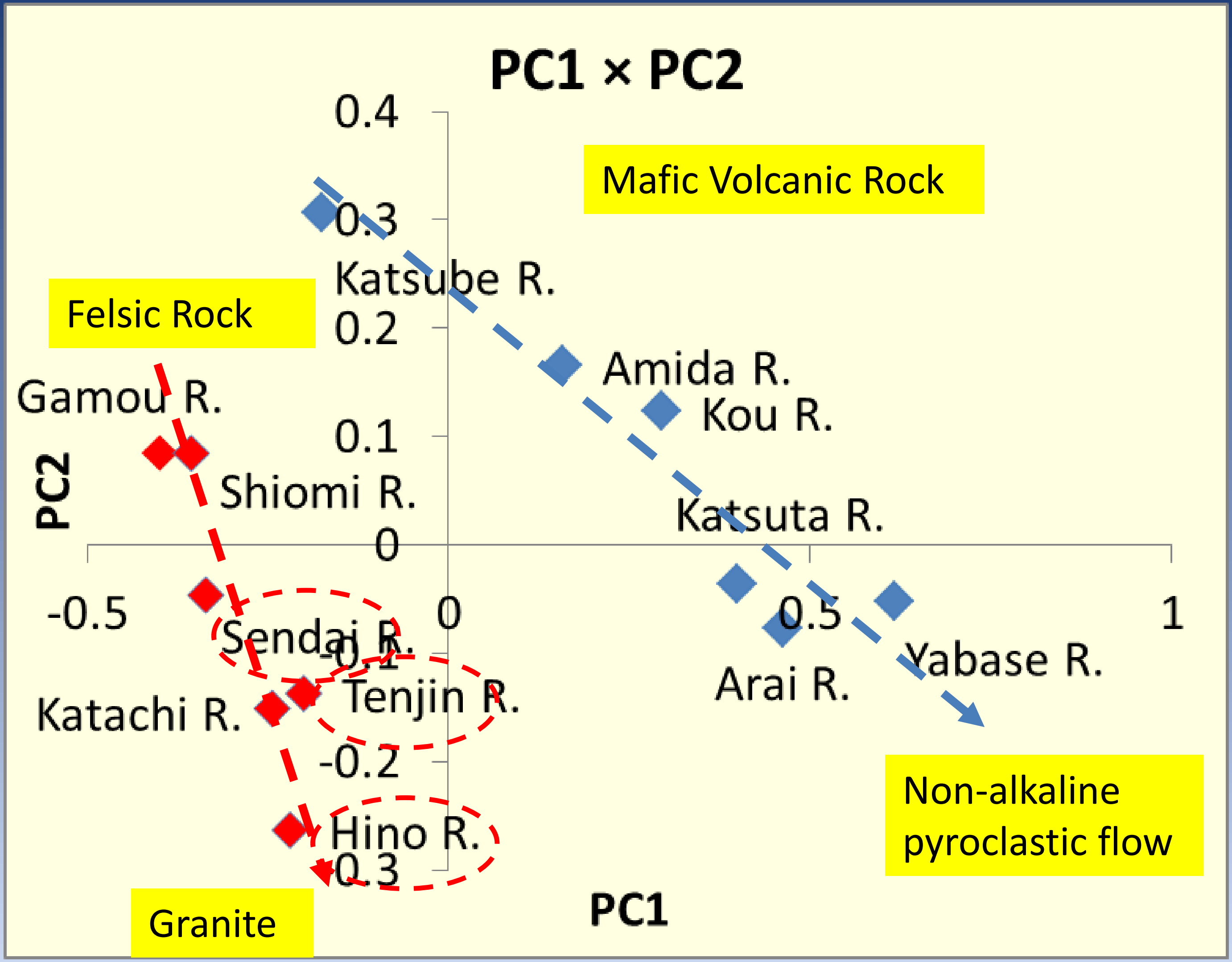
Geology of the rivers basins



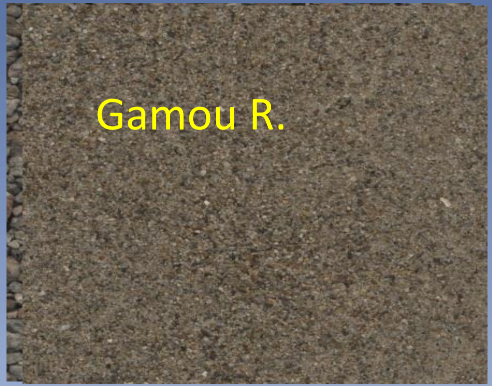
Principal Component Analysis



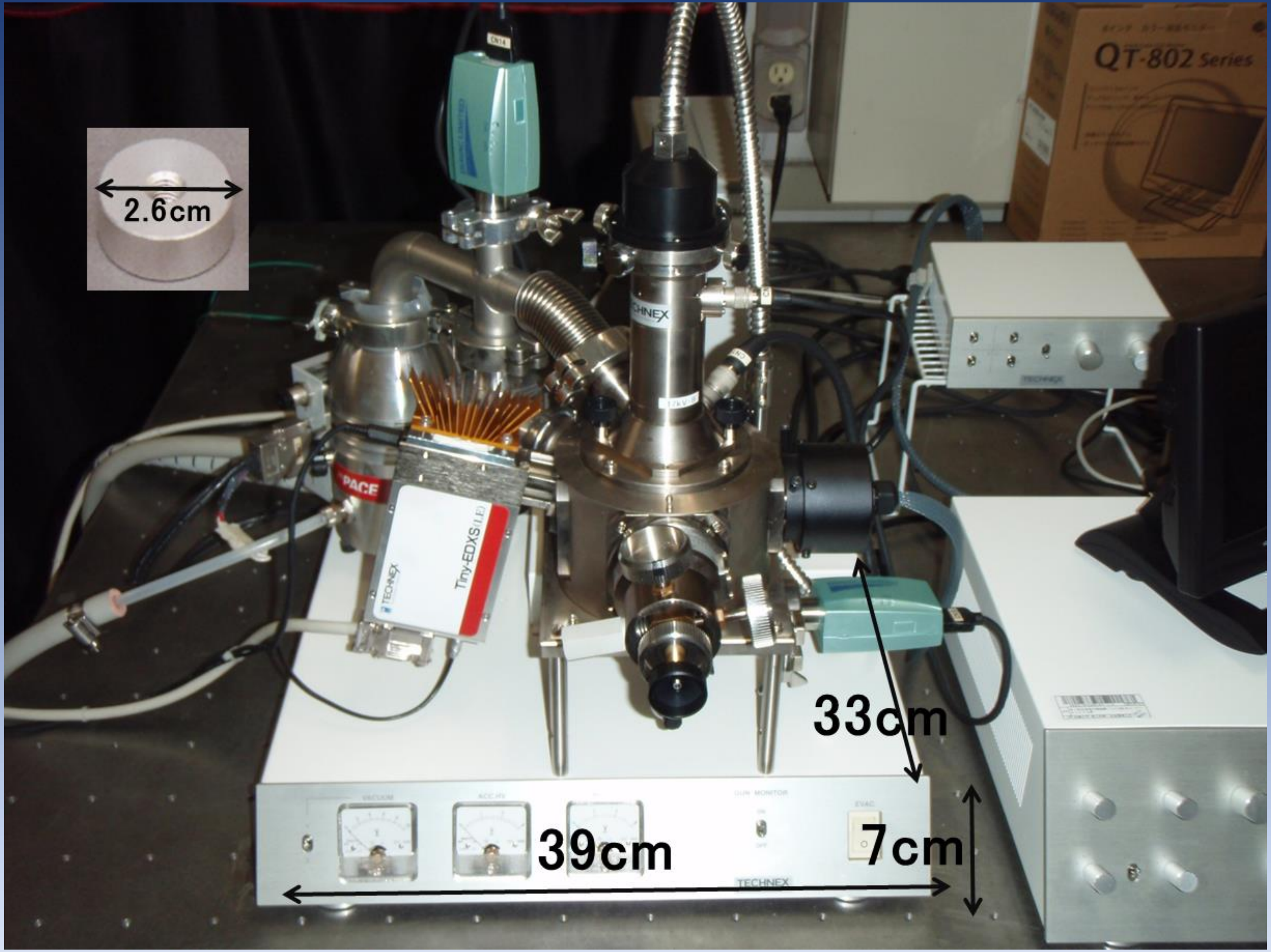




PC1:71.5% and PC2:13.5%



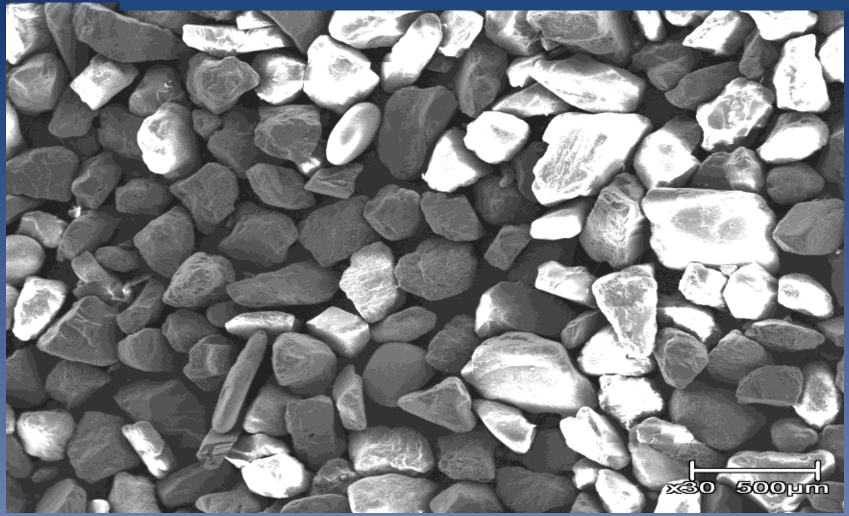
Analyses of sediment



- ・Energy Dispersive X-Ray Spectrometer
- ・0.3㎜　or less than

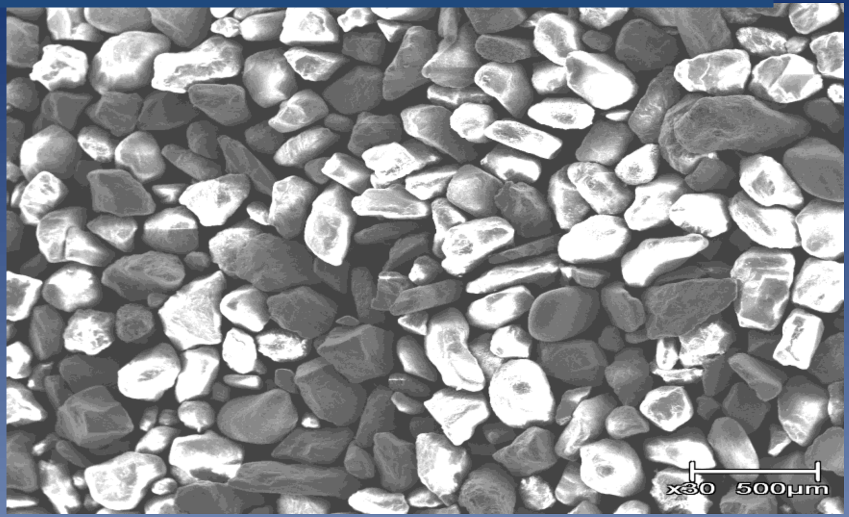
Analyses of Sediment

2.4mm

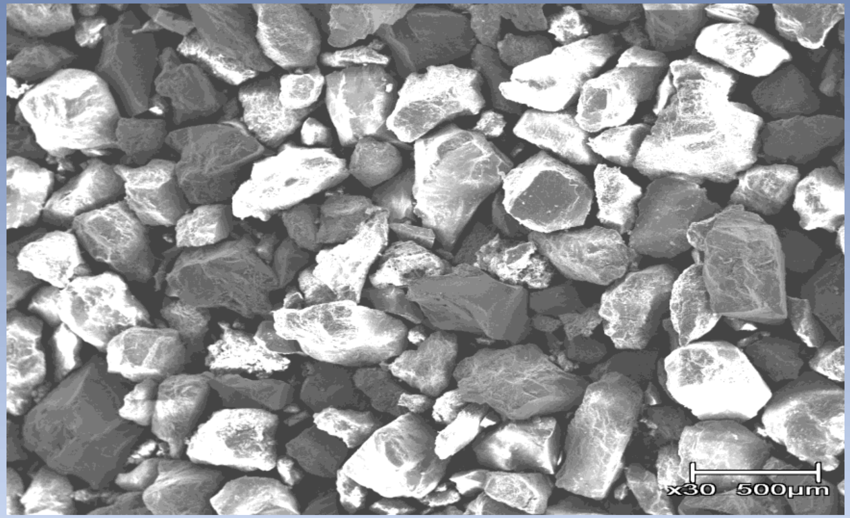


Mizushiri Beach

3.2mm



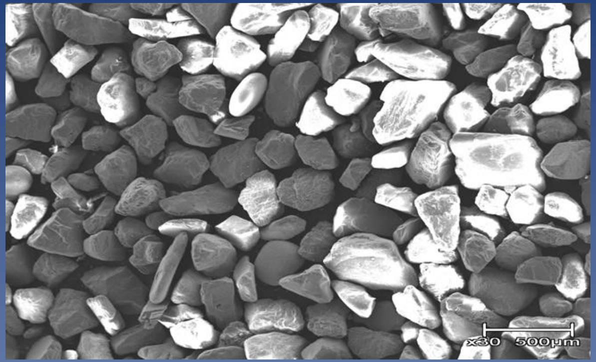
Sand dune

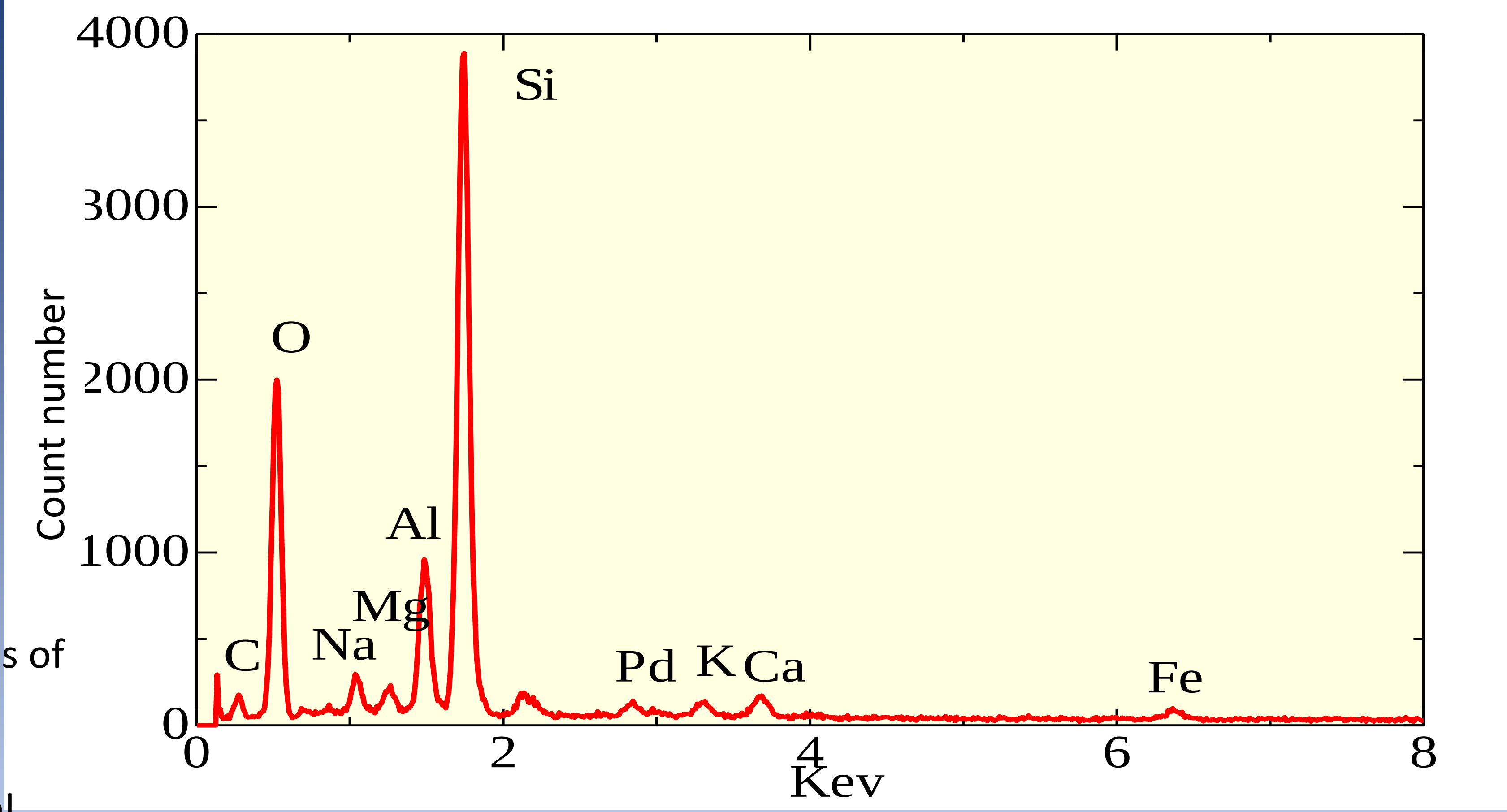


Hino R.

Sendai R.

X-ray spectrometer analysis of beach sands

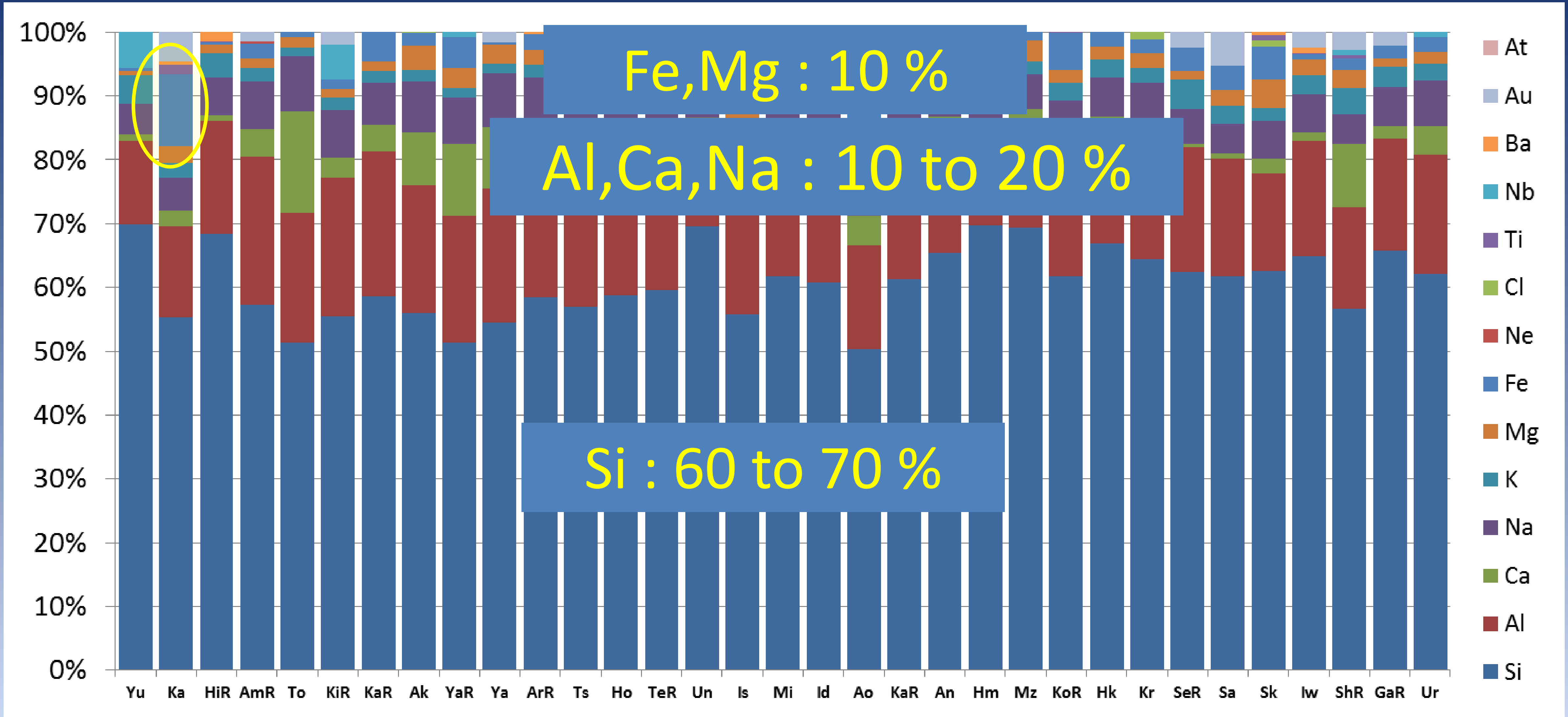




The energy values and the intensities of the specific X - rays of the elements contained in the sediment were measured, and the types of chemical elements contained in the sediment and their proportions were determined.

Element corresponding to the energy of the X-ray

Chemical elements at sites



14 types of chemical element

How to analyze the elements

Empirical Orthogonal Function

Chemical Element: X

Sampling Site: i

Composition Ratio of X at sampling site i :Gc(i,x)

Mean composition ration of X:Gc(x)

Gc(i , x)-Gc(x)＝ΣCn（x）･En（i）---------(1)

Where

Element composition function :Cn（x）

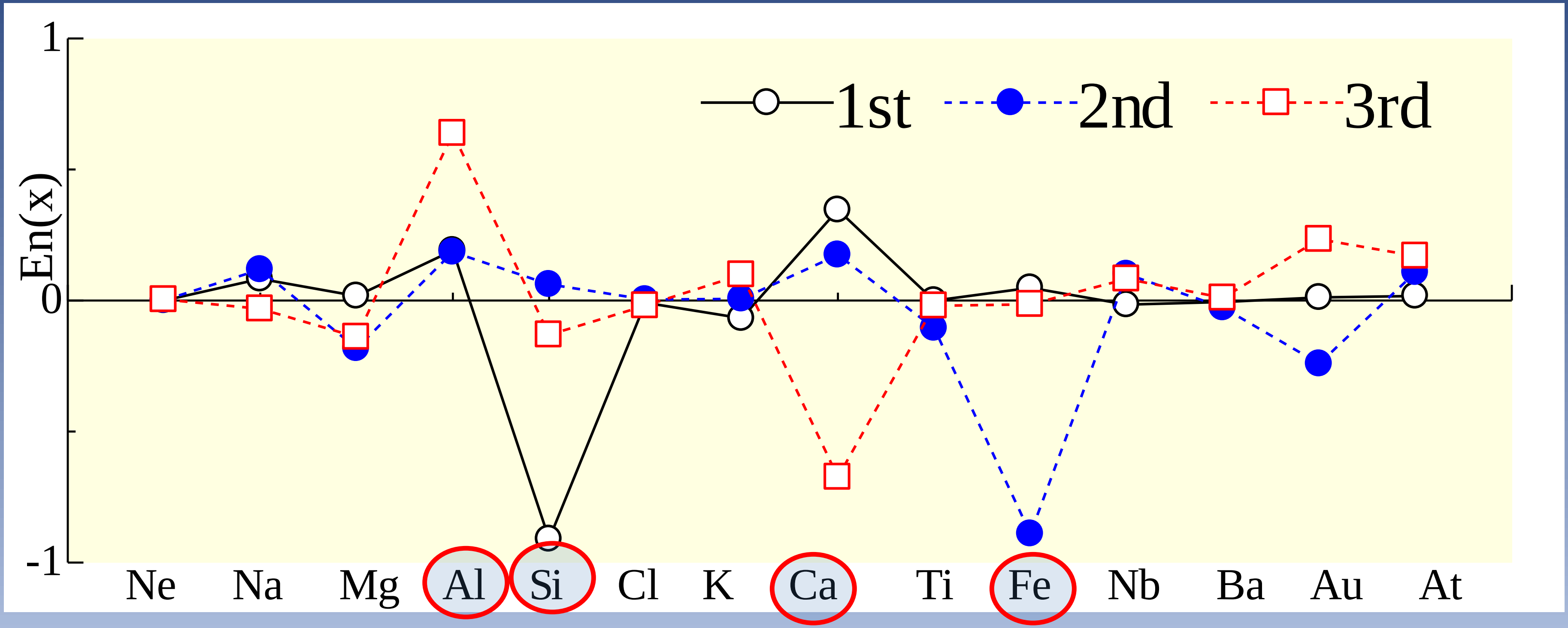
Space function :En（i）

K-means method

Cluster anlysis

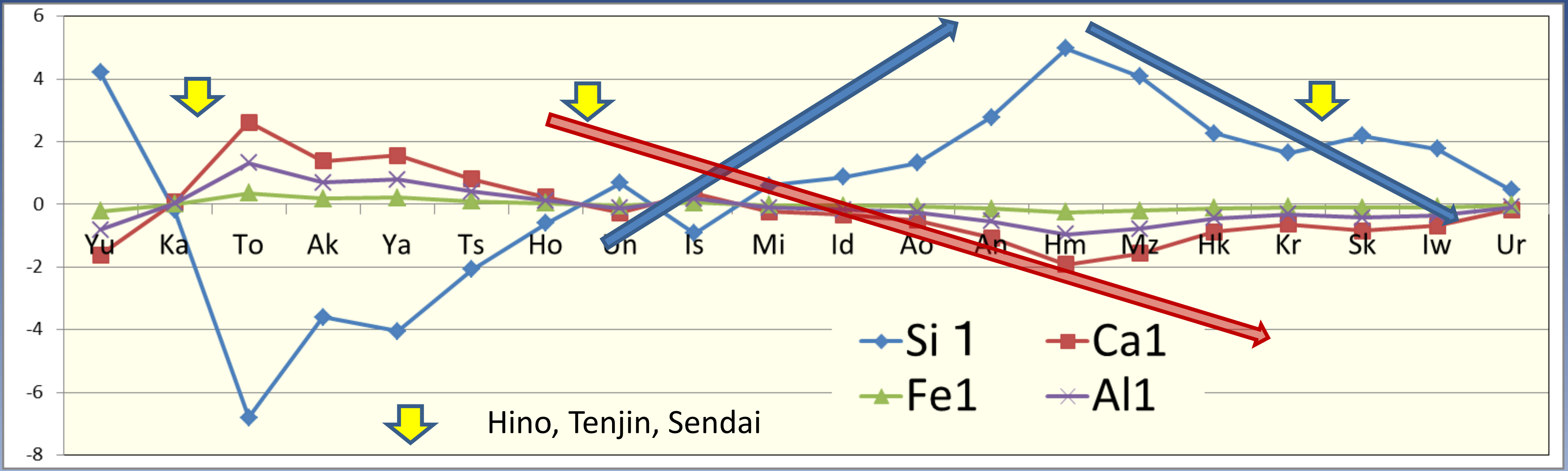
Correlation matrix method

Variations of En(x)



Contribution ratio：1st mode（64%）、2nd mode（17%）、3rd mode（8%）

Variations of 1st mode of Cn(x)

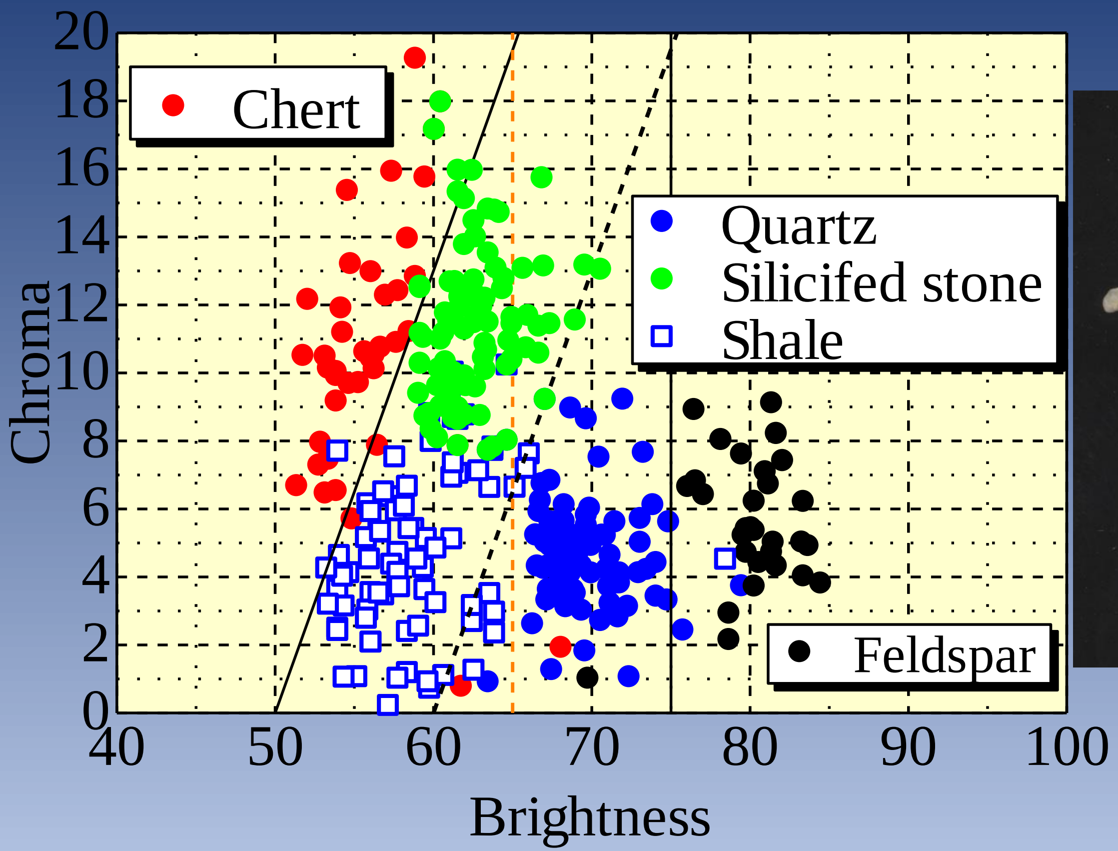


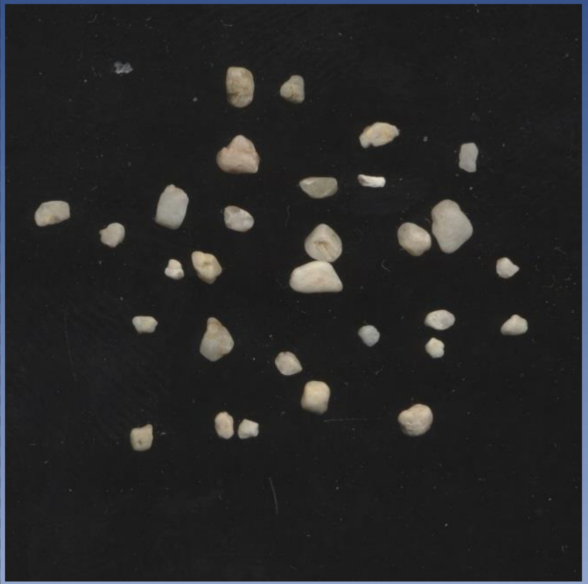
Si has a negative correlation between Al and Ca, and as the quartz content increases, the content of feldspar decreases.

As the sediment moves

Anorthite ($CaAl_2Si_2O_8$) => Plagioclase($NaAlSi_3O_8$) => potassium feldspar ($KAlSi_3O_8$) => Quartz (SiO_2)

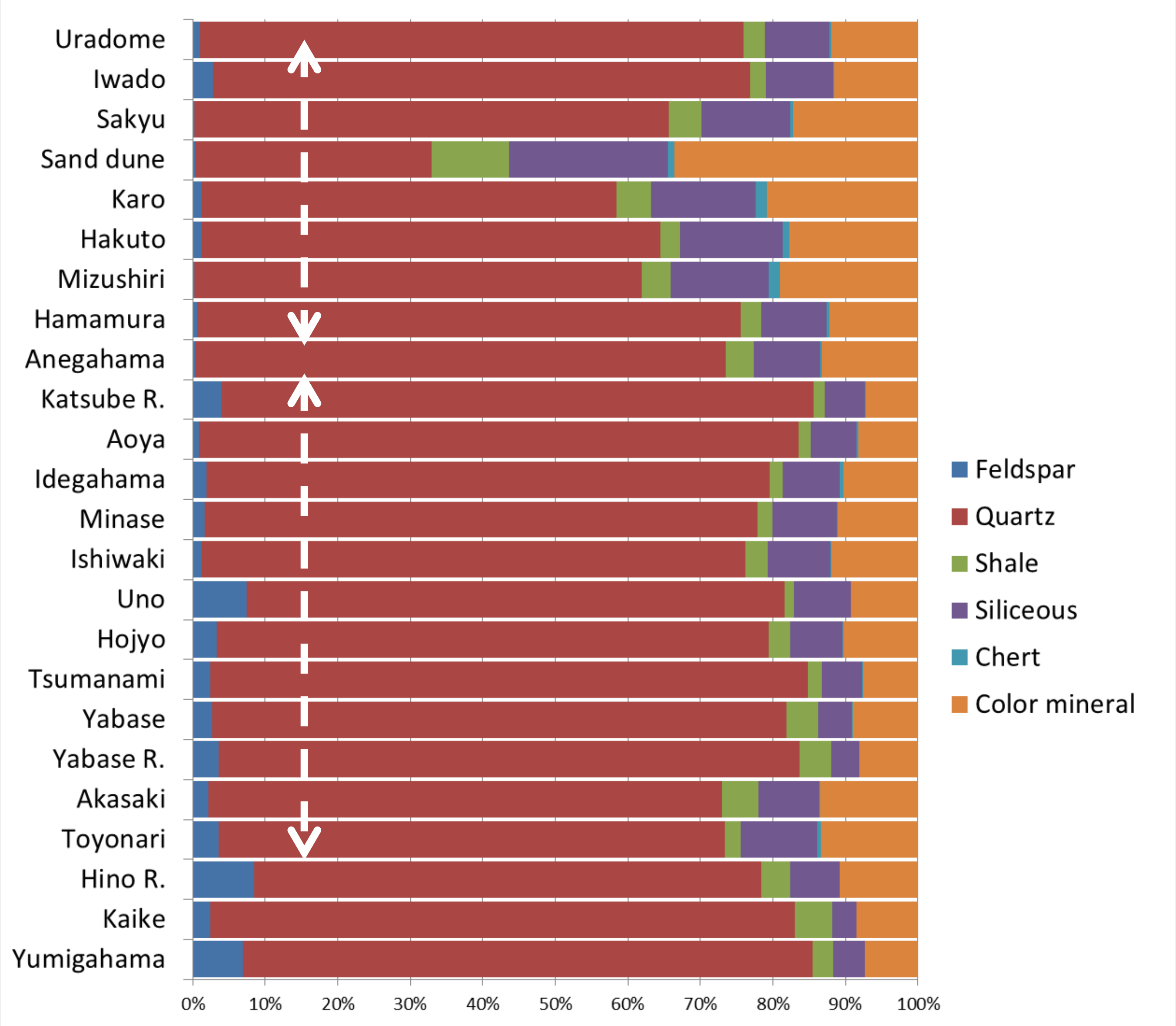
How to Classify Mineral Composition Component





Classification of Mineral Composition Component

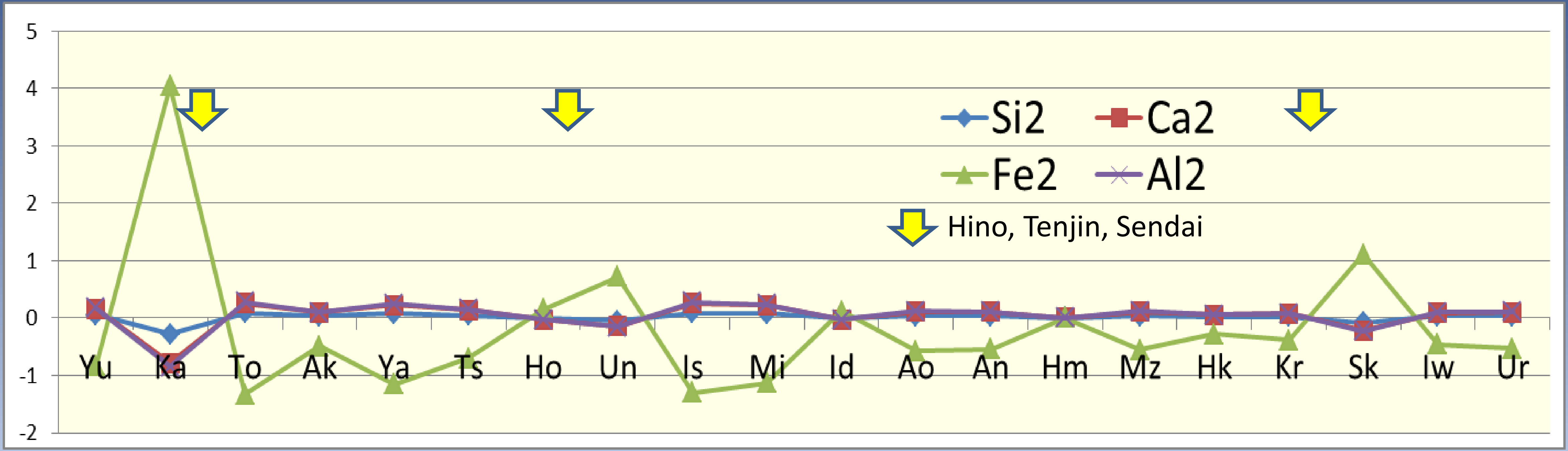
there are almost no feldspars from Anegahama coast to Uradome coast, and quartz gradually decreases,



Corresponding to the variation of Si element

Feldspar has decreased and as a result quartz increased

Variations of 2nd mode of Cn(x)

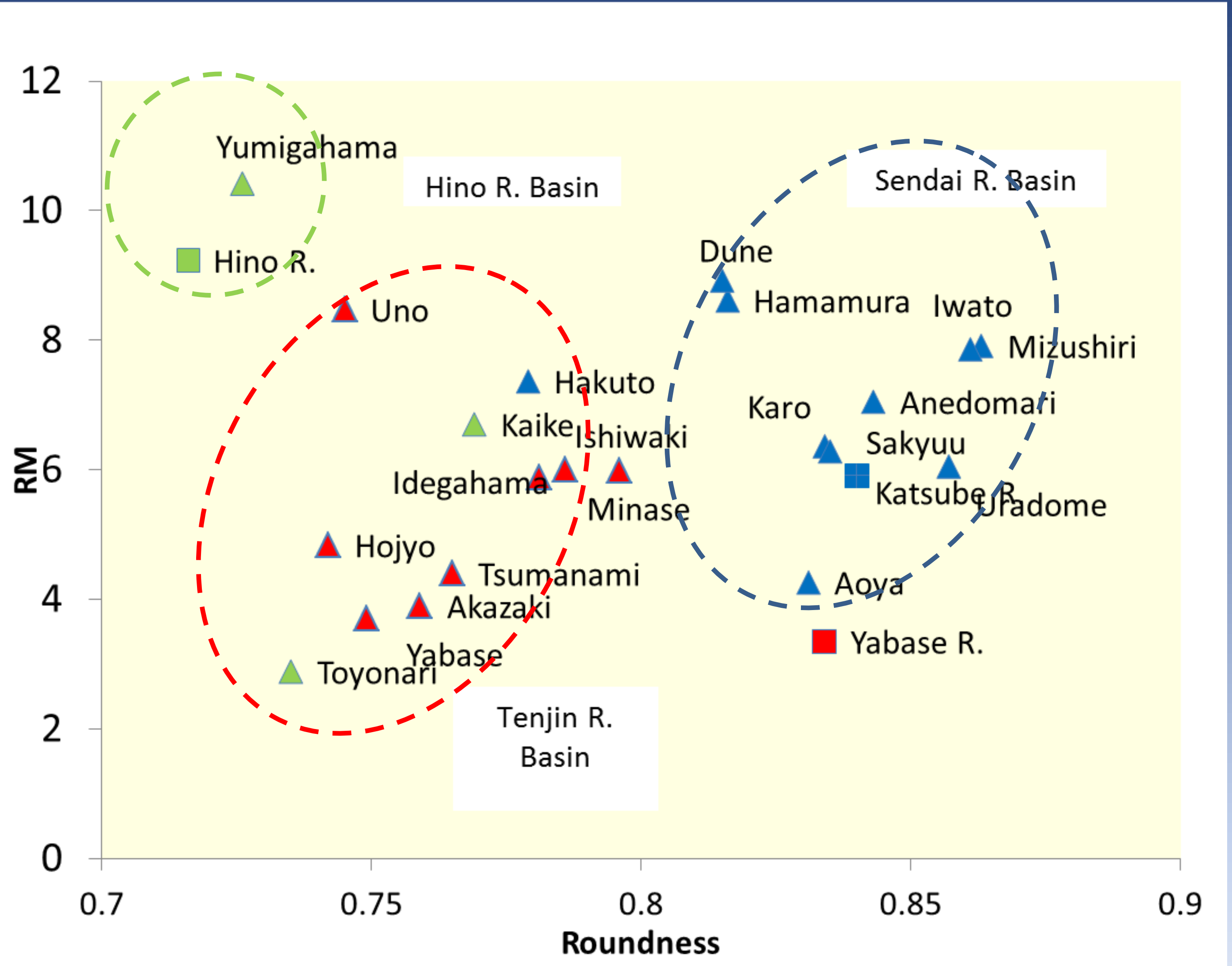


Geochemical Maturity based on RM and Grain Roundness

RM

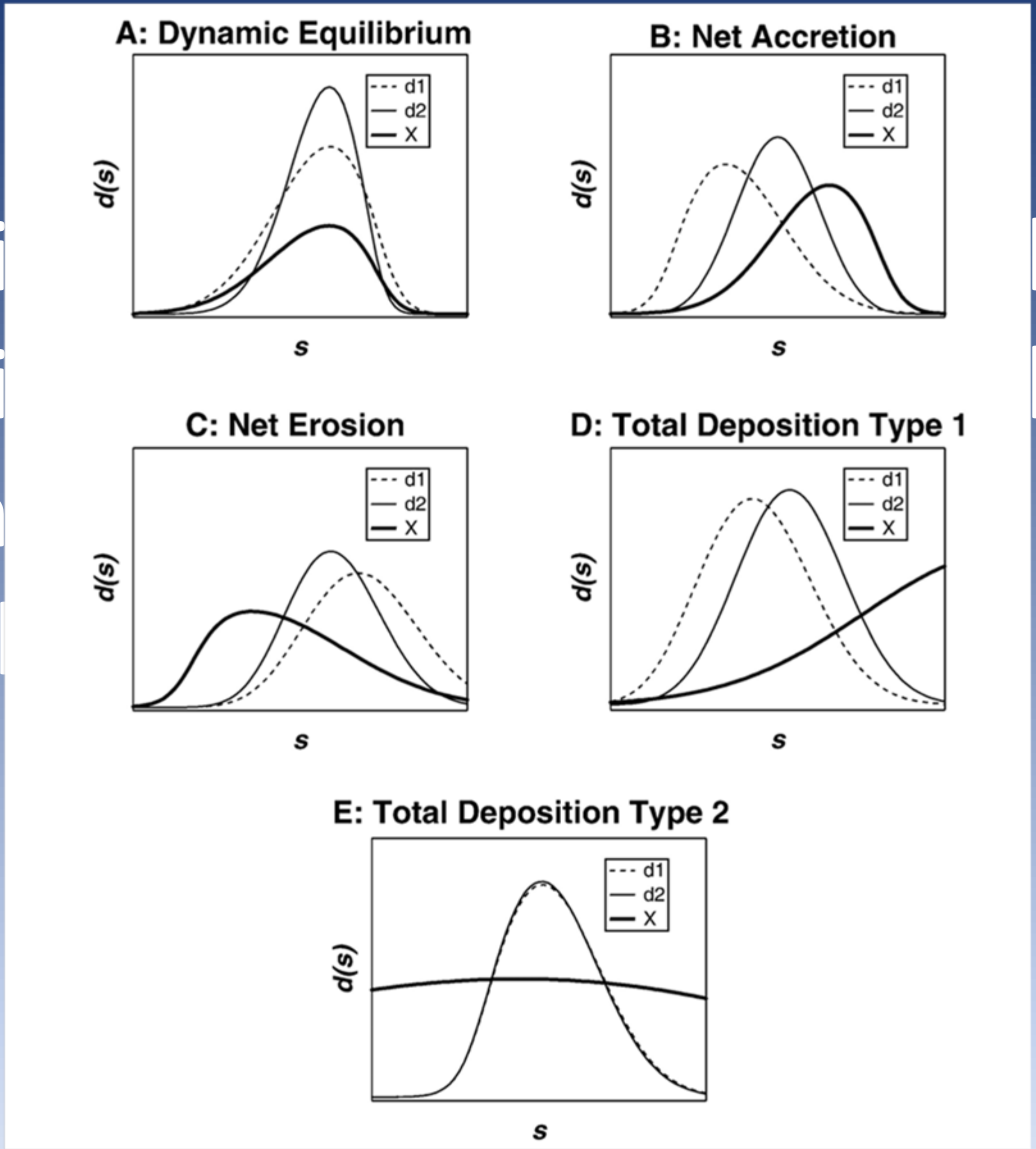
$SiO2/(NaO_2+CaO+K_2O+MgO)$

・Geochemical maturity is that quartz is dominant, and roundness of sand grain is high.
・With increasing sediment maturity, quartz survives preferentially to feldspars, mafic minerals and lithics.
・Maturity can be evaluated by RM and roundness.
・The sediment of the Sendai River basin can be said to be higher maturity.

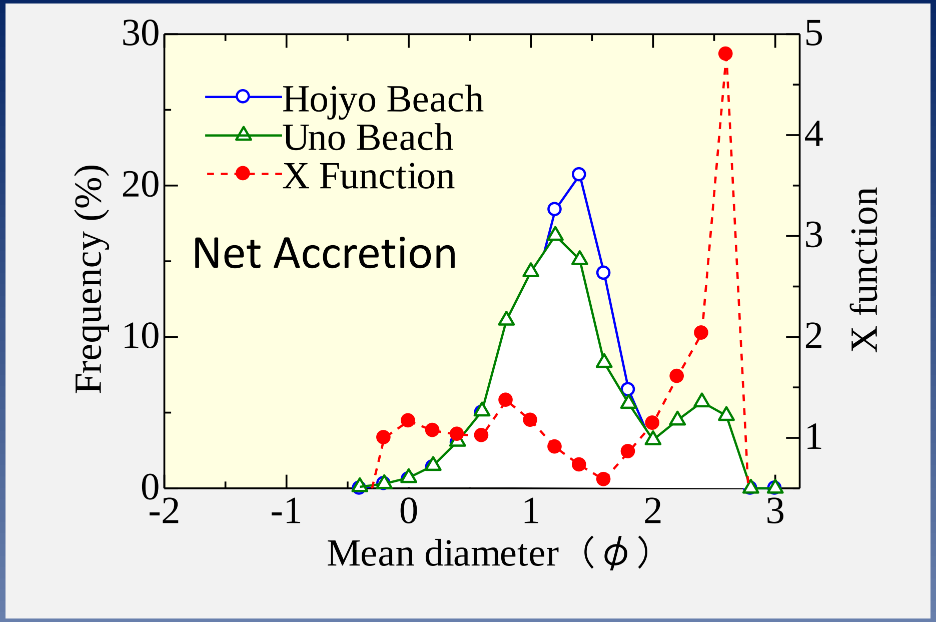


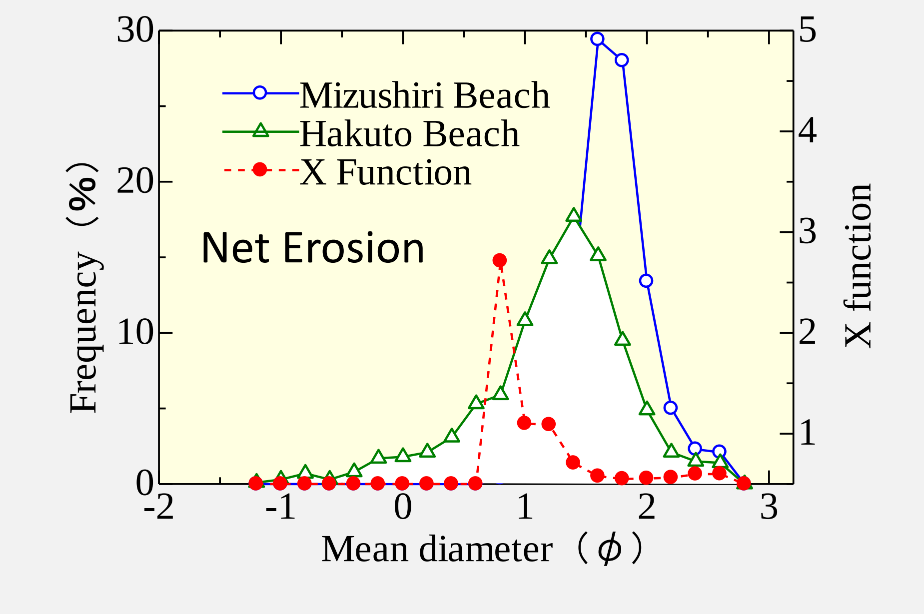
X-function

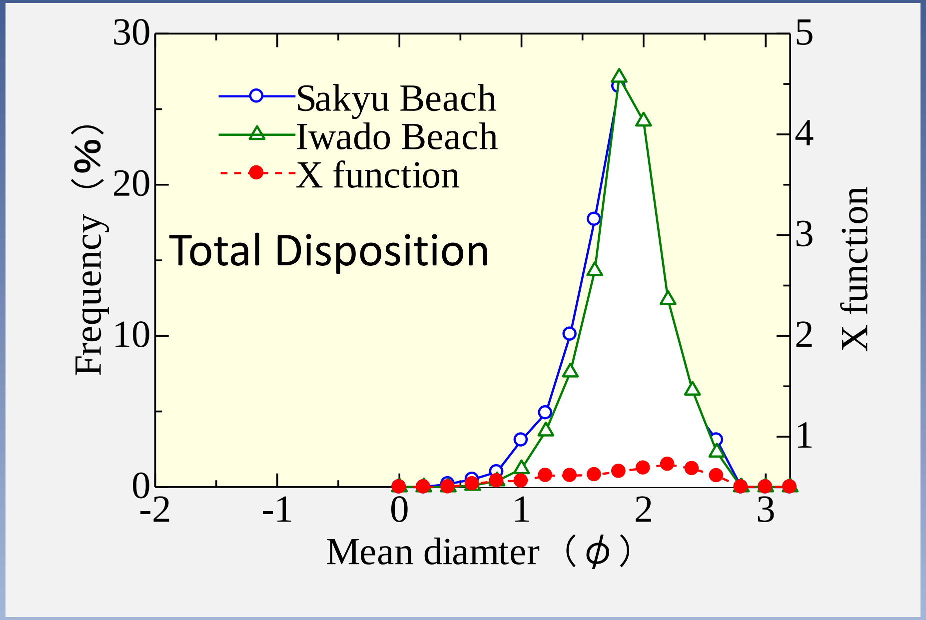
D1 :Distributi he upper side
D2 :Distributi he lower size
X(s) shows th between
adjacent



X-distribution and grain size distribution







Conclusions

1. Chemical elements estimated from the geology of the river basin are corresponding to the mineral compositions at the sampling sites.
2. Si, Al, Ca, and Fe are the dominant elements.
3. Relationship between the spatial variations of Si and beach type
4. Increasing of Si is corresponding to high maturity and accretion type
5. Decreasing of Si to low and erosion type

Conclusions

Variation of Silica	RM	Beach Type
Increase	Mature	Net Acceration
Decrease	Immature	Net Erosion
Non	Moderate	Total Diposition
RM: Resistant Index of Maturity		



Thank for your attentions



X-function

Dynamic Equilibrium : The shape of the X-function resemble the D1 and D2

Net Accretion: The mode of X is finer than the modes of D1 and D2.The grain size becomes finer in the direction of transport; however, more finer grains are deposited along the transport path than are eroded, with the result that the bed, though mobile , is accreting.

X-function

Net Erosion : The mode of X is coarser than the modes of D1 and D2. Sediment coarsens along the transport path, more grain are eroded than deposited and the bed is undergoing net erosion.

Total Deposition : Regardless of the shapes of D1 and D2, the X more or less increase monotonically over the complete size range of the deposits. The grain size must become finer in the direction of transport; however, the bed is no longer mobile. Rather, it is accreting under a “rain” of sediment that becomes finer with distance from source. Once deposited, there is no further transport.

Background & Objective

1994 2011 Chiri beach

An understanding of sediment transport and its distribution is important in managing the sandy beaches.

Empirical Orthogonal Function

Chemical Element : X

Sampling Site : i

Composition Ratio of X at sampling site I :Gc(i,x)

Mean composition ration of X:Gc(x)

Gc(i , x)-Gc(x)＝ΣCn（x）･En（i）------------(1)

Where

Chemical element composition function :En（i）

Spatial function :Cn（x）