SR-ND ISOTOPES AND MAJOR ELEMENTS COMPOSITION OF SUSPENDED SEDIMENTS FROM AMAZON BASIN MAIN RIVERS

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GEOLOGICAL SETTINGS

Legend:
- Quaternary cover
- Tertiary cover
- Mesozoic rocks
- Paleozoic rocks
- Paleoproterozoic rocks
Analysis of Suspended Sediments in Water

Period: 2009/2010 hydrological year

- Suspended Sediments Concentrations (SSC)
- Major Elements Concentration
- One mineralogy analyse
- $^{87}$Sr/$^{86}$Sr and $^{143}$Nd/$^{144}$Nd isotopic concentration

(Ion-CP-OES) Optical emission spectrometry with inductively coupled plasma

X-Ray Diffraction

(TIMS) Thermal ionization mass spectrometry
QUESTIONS WE INTEND TO ANSWER (ARE)

How to interpret the differences of Sr-Nd isotopes signals in relation to sediment sources?

Is there any difference between Sr isotope signals comparing to those from the dissolved phase?

Will these geographical tracers respond to temporal changes in one hydrological year?

How does suspended matter interact with water discharge?
MOREHEAD ET AL. (2003)

A - clockwise loops: high concentrated sediment water input on the rising flood
B - counterclockwise loops: higher concentrations on the falling limb
C - Complex sediment concentration loops: changing water and sediment sources throughout a season

MARTINEZ ET AL. (2009)
2009/2010 HYDROLOGICAL CYCLE

- **Borja**
- **Rurrenabaque**
- **Letícia**
- **Porto Velho**
- **Manacapuru**
- **Óbidos**
**MAJOR ELEMENTS**

- **Borja** presents high concentration of immature elements: local erosion;

- **Leticia** presents the lowest elements concentration values: Marañón plain as a zone of sedimentation (Leier et al., 2013);

- **Manacapuru** is more enriched and homogeneous: all the Andean tributaries from north of the Equator and some from the Amazon River's southern side (Filizola & Guyot, 2009);

- **Madeira River** presents smaller values in high water discharge periods: PV > RU;

- **Obidos** station: the pattern along the hydrological year is more homogeneous
**Dissolved matter:**
Dissolution of evaporites plays an important role in the Solimões River and in the Amazon main stream; The Madeira River does not appear to be influenced by evaporite dissolution.

**Suspended Sediment matter:**
Silicates: main end member; Evaporites: Solimões River > Madeira River; Borja: evaporites and carbonate influence.
Borja Source
TDM Precambrian x Carbonate Rocks
Scherrenberg et al. (2012)

Gonzales and Pfiffner (2012)
MINERALOGY AT BORJA

The high calcium content from Borja station led to research the suspended sediment mineralogical composition.
The mineralogy obtained is compound by:
- quartz and muscovite as major elements;
- calcite, chlorite and kaolinite as minor elements;
- and pyrophyllite, rutile and albite as trace elements.
The Sr isotopic composition of the suspended load is strongly affected by the seasonal variation. The Sr isotopic composition becomes more radiogenic when the suspended sediment concentration increases.
$^{143}\text{Nd}/^{144}\text{Nd}$ Sazonal Variation
Model age through river

Denudation rates converge to a spatially averaged erosion signal in the floodplain which is insensitive to local effects of mass transport in the source area. (Wittmann et al., 2009)
SR ISOTOPES COMPOSITION
DISSOLVED vs SOLID LOAD

Dissolved concentrations (Santos et al)

dissolution of carbonate or evaporite ($^{87}\text{Sr}/^{86}\text{Sr} < 0.709$)
atmospheric input ($^{87}\text{Sr}/^{86}\text{Sr} = 0.709$).
SOURCES

BASU ET AL. (1990)
Plot of $f_{\text{Sm/Nd}}$ (fractional deviation of $^{147}\text{Sm}/^{144}\text{Nd}$ from CHUR) vs. $\varepsilon_{\text{Nd}}$. Also shown are fields of published data for South American cratonic rocks and Andean igneous rocks (data from many sources), Andean foreland basin sediment (Basu et al., 1990), Amazon River sediment (Goldstein et al., 1984) and reference isochrons of 1800 and 1500 Ma.
RODDAZ ET AL. (2005)

[Diagram showing geographical and isotopic data related to the Solimões and Madeira rivers, with annotations for various locations and formations.]

- Solimões River
- Madeira River
- Borja
- Leticia
- Manacapuru
- Óbidos
- Porto Velho
- Rurrenabaque
- 87Sr/86Sr isotopic ratios and δ18O values plotted on the graph.
CONCLUSION

- Concerning to suspended matter and water interaction, large river system displays a clockwise hysteresis with small sediment load variations. Solimões’ small river system present complex sediment concentration loops, otherwise Madeira small river system exhibit a more direct relation. This may reveal different types of hydrological land interaction;

- Silicate weathering displays the most important role on Amazon suspended sediments.

- Borja elements reveals local erosion probably related with Paleozoic-Mesozoic carbonates

- Sr isotopic rates of suspended sediment displays sazonal variability unlike Nd isotopic rates. Denudation rates converge to a spatially averaged erosion signal in the floodplain ;

- Sr isotopic ratios on suspended sediments are more radiogenic than those of dissolved phase and Madeira river presents higher differences between these two phases in comparison to Solimões river.

- Main sources are from Andean foreland basins. Manacapuru and Óbidos don’t exhibit typical characteristic from these sources.
THANK YOU