with a presentation on the first quantita-
tive pollen-inferred Holocene land-cover in
northwest Europe achieved within the
Swedish LANDCLIM project (Gaillard et
al., 2010). Lectures on the second day in-
cluded an introduction to dynamic vegeta-
tion models, tools for spatial analyses, and
studies in other regions (tropical Africa and
Australasia). The third day comprised of in-
vited talks on the dry evergreen forests of
south India, Sri Lanka and Borneo were presented during several
lecture and poster sessions (Fig. 1).

As a concrete result of the workshop,
three geographical regions of focus on the
Indian subcontinent and their respective
regional coordinators were identified, (1)
Western Himalayas, (2) Eastern Himalayas,
and (3) Peninsular India with Sri Lanka.
These regions will each move forward in
developing the following research themes
(with their respective thematic coordina-
tors):
A) Indian pollen database (to be housed at
the IFP) and application of the biomiza-
tion approach.
B) Pollen productivity estimates and land-
scape reconstruction algorithm applica-
tion.

For the names of regional and thematic
coordinators, please see the supplementa-
tary material (http://www.pages-igbp.org/
products/newsletters/ref2011_2.pdf) or
contact the first author of this report. The
research stemming from the above men-
tioned aims will contribute to the PAGES
Focus 4 PHAROS themes of Regional Inte-
gration and Land-cover and Use.

A post-workshop excursion to a 30
year afforestation effort of the Sri Aurobin-
do International Centre of Education, aptly
illustrated land-cover changes and positive
aspects of human intervention through
restoration ecology.

References
Gaillard, M.-J., et al., 2010: Holocene land-cover reconstructions for
studies on land cover climate feedbacks, Climate of the Past, 6:
485-499.
Sugita, S., 2007a: Theory of quantitative reconstruction of vegetation I.
Pollen from large sites REVEALS regional vegetation, The Holoco-
me, 17: 229-241.
Sugita, S., 2007b: Theory of quantitative reconstruction of vegetation II:
all you need is LOVE, The Holocene, 17: 249-257.
Anupama, K., Sudhakar, S., Prasad, S. and Pujre, G.S., 2008: Temporal
dynamics using a spatially resolved technique: applying RS to
target sites for reconstructing vegetation history in the Eastern
Ghats, Proceedings of the National Seminar on Conservation of the
Eastern Ghats, December 28-29, 2007, ENVIS Centre, Hyderabad,
474-477.
Gunrell, Y. and Anupama, K., 2003: Past and Present Status of Runoff
Harvesting Systems in Dryland Peninsular India: A Critical Re-

For full references please consult:

2010 international workshop on XRF core scanning
Texel, The Netherlands, 8-10 September 2010

Rik Tjallingii1, Y. Hamann2, D. Garbe-Schönberg3, G. Jan Weltje4, U. Rohlf5 and workshop participants

1NIOZ-Royal Netherlands Institute for Sea Research, Texel, The Netherlands; Rik.Tjallingii@nioz.nl
2Geological Institute, ETH, Zürich, Switzerland; 3Institute of Geosciences, CAU University of Kiel, Germany; 4Department of Geotechnology, Delft University of Technology, The Netherlands; 5MARUM-Center for Marine Environmental Sciences, University of Bremen, Germany

Over the last decade, X-ray fluorescence
(XRF) core scanning has become an estab-
lished method for non-destructive and
fast acquisition of sediment compositions
(i.e., element count rates) directly at the
surface of split cores. State-of-the-art core
scanners can measure element intensities
at sub-millimeter resolution that allow
detailed recording of compositional vari-
atations in finely laminated and even varred
sediments. Core-scanning data are widely
applied to paleoceanographic and pa-
everland reconstructions on timescales
ranging from seasonal to millions of years.
New developments in data processing and
calibration techniques have increased the
need to exchange experiences among
users at various laboratories equipped
with an XRF core-scanner. Therefore, a three-day workshop was held at the Royal Netherlands Institute for Sea Research to discuss technical aspects and application challenges of XRF core scanning, in particular Avaatech scanners, in the wider field of paleoceanography.

On the first day of the workshop, leading researchers and laboratories gave an overview on applications of geochemistry to scientific problems and on the quality of geochemical data generated by XRF core scanning. The quality of XRF core-scanner data is commonly evaluated by comparing core-scanner records with destructive analyses of discrete samples (e.g., Inductively Coupled Plasma (ICP)-Optical Emission Spectroscopy or ICP-Mass Spectroscopy). Geochemical data are closed-sum data that are intrinsically correlated and cannot be directly quantified on an element-by-element basis. Geochemical data are therefore often represented as element ratios in order to interpret down-core composition variations in terms of changes in climate and environment, sediment transport mechanisms, or diagenetic conditions. Additionally, element intensities from XRF scanners are not solely related to element concentrations, but are also affected by down-core variations of physical sediment properties (size distribution, density, water content), as well as absorption and enhancement effects, and measurement geometry. It was shown that the log-ratio representation of XRF count rates and concentrations allows effective minimization of the noise caused by these down-core variations, and allows enhancement of the signal-to-noise ratio by means of appropriate multivariate filtering techniques. Log-ratio calibration permits rigorous quantification of the precision of XRF core-scanner data based on replicate measurements, which paves the way to fully quantitative applications of XRF core scanning.

The second day was dedicated to the discussion of the mathematical transformation of XRF spectra into elemental count rates by least-squares fitting of the characteristic X-ray peaks. Practical problems concerning data processing and goodness-of-fit parameters (e.g., chi-squared $\chi^2$) were presented by members of the MARUM XRF core scanner laboratory of the University of Bremen, Germany. Many technical issues were discussed in a lively debate between XRF core-scanner users, specialists in XRF acquisition, and specialists in XRF spectrum evaluation.

The third day was devoted to complementary non-destructive scanning tools, which are optional for the latest scanners (e.g., visible-light and UV digital line-scan cameras, magnetic susceptibility sensors, radiograph imagery), and their applications to sediment and coral-core analysis. In addition, laser-ablation ICP-spectroscopy was presented as a complementary destructive chemical technique. In a final discussion, the workshop participants expressed the need for an electronic information platform to share practical experience on sample preparation, measurement techniques, data processing, technical solutions and preventive maintenance.

The next international workshop on XRF sediment core scanning will be held in two years time. More information about current developments concerning the electronic information platform and the workshop, including some of the presentations, is available at: www.nioz.nl/xrf-workshop

Figure 1: Comparing count rates and goodness-of-fit statistics of element silicon (Si) and iron (Fe) measured on certified geochemical reference standards (x-axis; e.g., http://georem.mpch-mainz.gwdg.de/) with an Avaatech core scanner equipped with (A) a pin-diode detector (X-PIPS) and (B) a silicon-drift detector (SDD). The newly developed SDD detector increases the count rate (black) but also chi-square statistics (red) for Si and Fe due to higher sensitivity of this detector. The relative standard deviation (blue) decreases indicating better signal-to-noise conditions for measurements acquired with the SDD detector. The relative standard deviation is calculated as D-Area/Element-Area. For practical reasons the chi-square and relative standard deviation are plotted on a logarithmic scale.

\begin{figure}[h]
\centering
\includegraphics[width=\textwidth]{figure1.png}
\caption{Comparing count rates and goodness-of-fit statistics of element silicon (Si) and iron (Fe) measured on certified geochemical reference standards (x-axis; e.g., http://georem.mpch-mainz.gwdg.de/) with an Avaatech core scanner equipped with (A) a pin-diode detector (X-PIPS) and (B) a silicon-drift detector (SDD). The newly developed SDD detector increases the count rate (black) but also chi-square statistics (red) for Si and Fe due to higher sensitivity of this detector. The relative standard deviation (blue) decreases indicating better signal-to-noise conditions for measurements acquired with the SDD detector. The relative standard deviation is calculated as D-Area/Element-Area. For practical reasons the chi-square and relative standard deviation are plotted on a logarithmic scale.}
\end{figure}