XMaS the UK-CRG	**Experiment title:** Combined XRF and scatter measurements of normal and diseased breast tissue	**Experiment number**: 28-01-640
Beamline: **BM 28**	**Date of experiment**: from: 15th December to: 18th December 2003	**Date of report**: 28th January 2004
Shifts: 9 shifts single bunch	**Local contact(s)**: David Paul	*Received at XMaS:*

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Report:

The aim of this experiment was to further our work on characterising breast tissue abnormalities using XRF and x-ray scattering techniques. We have already established elevated levels of certain trace elements in breast tumours compared to healthy breast tissue. However, our results show a wide variability in individual levels and this experiment was to investigate a possible cause for this variation. One of the problems with biopsy samples is that although characterised as “tumour”, they will inevitable contain tissue of non disease status e.g. adipose tissue. In our experiments using BM28 our beam size is typically 0.5 mm to 1.0 mm incident on a sample of dimension up to 15 mm diameter. Our thinking was that if we targeted a tumour sample at a position that corresponded to adipose content, the resulting trace element levels would not be indicative of tumour. One method of establishing adipose and fibrous content of samples is to utilise measurements of the coherent scatter profiles, the characteristic peaks being easily resolvable. In this experiment we used the 2 theta arm to measure the scatter profiles and at the same time (hence position) measured the XRF response so we could try to find any correlation between the two parameters.

The diffraction patterns confirmed the significantly different compositon of healthy tissue and tumours in terms of adipose/fibrous content (figure 1). However no obvious links between the two parameters (elemental composition and composition) were found with any statistical significance. This result needs to be confirmed with a larger sample throughput but we are fairly sure we can now eliminate the varying adipose content of the samples as being a factor in the wide range of elemental levels within a given category of tissue.

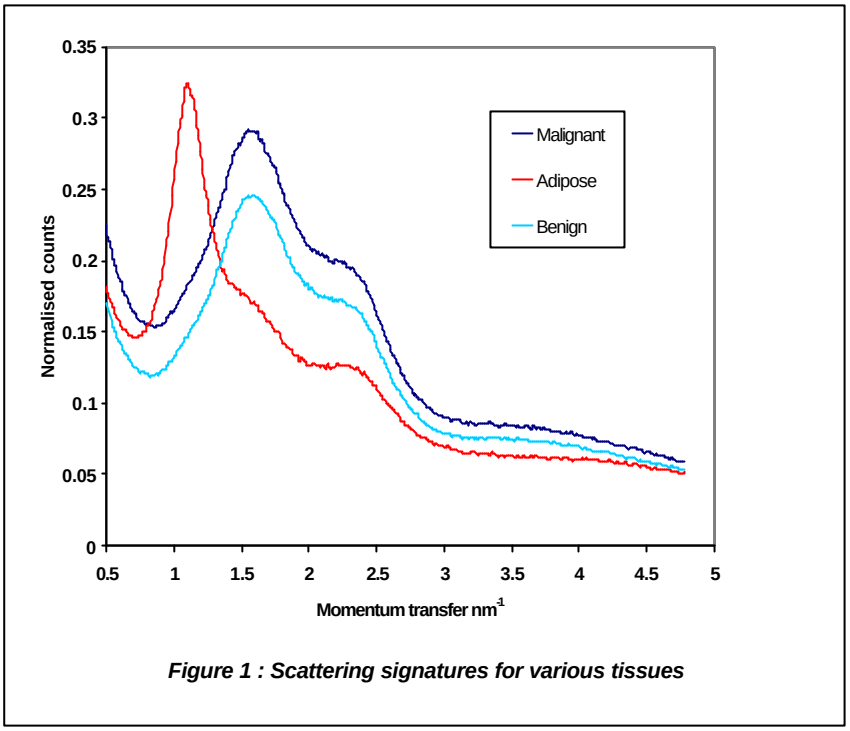

Figure 1 : Scattering signatures for various tissues

For the XRF measurements this time we used a Peltier cooled Si detector which proved to be of sufficient resolution at low energies for us to be able to quantify elements that in the past experiments have been impossible. Figure 2 shows the spectrum over the

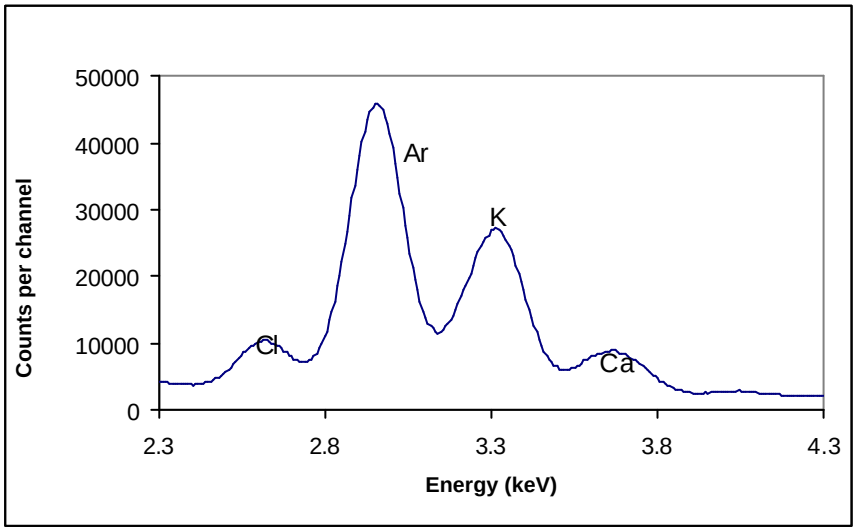

Figure 2 ; previously unresolvable elements Cl, S and Ca. (NB argon is due to air)

low energy range of interest that has enabled us to examine healthy tumour ratios for S, Cl and Ca for 12 matched pairs. Again significant differences seem to be appearing and this requires further samples throughput for confirmation.

Publications to date from our work on BM28 are:

1. Geraki K. **Farquharson M.J**. and Bradley 2002 Concentrations of Fe, Cu and Zn in breast tissue, a synchrotron study. *Phys. Med. Biol.* **47(13)** 2327-2339

2. Geraki K., **Farquharson M.J**. Bradley D.A. and Hugtenburg R.P. 2004 A synchrotron XRF study on trace elements and potassium in breast tissue *Nuclear Instruments and Methods in Phyiscs Research B* **213** 564-568

3. **Farquharson M.J**. and Geraki K. 2004 The use of combined trace element XRF and EDXRD data as a histopathology tool using a multivariate analysis approach in characterising breast tissue. *X-Ray Spectrometry* In press.

4. Geraki K, **Farquharson M.J**. and Bradley D.A. 2004 X-ray fluorescence and energy dispersive x-ray diffraction for the quantification of elemental concentrations in breast tissue. *Phys. Med Biol* **49** (1) 99-110