Petrographic analysis is performed to characterise coals (eg exploration programs), to confirm expectations of coals (eg. certification, research and other technical application including blending and predictions) and assess utilisation potential.

The Petrography and Imaging Centre (PIC), formerly known as ACIRL’s Petrography Laboratory, has performed petrography testing for over forty years. The PIC is based at ALS Coal’s Richlands Laboratory and is one of the largest petrography laboratories in the world with 8 ICCP (International Committee for Coal and Organic Petrology) accredited petrographers. Additionally the PIC is NATA accredited for petrographic analysis to Australian and ISO standard methods, and is the only petrography laboratory in Australia with this type of accreditation. The PIC is available for routine petrographic services for borecore, production and superintending samples. Additionally the PIC is available for more complex coal petrographic applications such as predictions, commenting on the oxidation of a coal sample, petrographic analysis of blends, identification of coal origin, and microscopic analysis.

**Petrographic Sample Preparation**

The PIC prides itself on excellence in petrographic sample preparation and uses a Struers Tegra Semi Automated polisher and high quality consumables. All samples are prepared in accordance with AS2856.1 (Coal petrography - Preparation of coal samples for incident light microscopy) and ISO7404.2 (Methods for the petrographic analysis of coals - Part 2: Methods of preparing coal samples). Petrographic grain mounts are set in a fast cure acrylic resin requiring no heat or pressure. Once completely cured the sample is cut back and polished using subsequently finer grades of silicone carbide grinding papers and diamond polishing suspensions. All samples are then microscopically inspected to ensure that the polished surface is free from scratches, relief and other polishing artifacts that may affect the results. Previous inhouse research found that water absorbed during polishing may significantly suppress the reflectance result obtained. Experiments conducted by the PIC have found that this error maybe up to 0.07 percent, which is greater than the repeatability limits for mean maximum reflectance analysis. The effect of water of reflectance measurement is variable and is eliminated by drying in a dessicator cabinet for at least 16 hours. This ensures that any water absorbed by the coal during the polishing process is removed.
**Vitrinite Reflectance**

Vitrinite Reflectance is a direct measure of the rank of coal and is known to be a major factor affecting coke quality. Vitrinite reflectance is the amount of light that is reflected from vitrinite in a polished surface of a coal sample and can be measured by a photometer or by the greyscale intensity in a high quality image. The test is carried out according to AS2856.3 (Coal Petrography Part 3: Methods for microscopical determination of the reflectance of coal macerals) or ISO 7404.5 (Methods for the petrographic analysis of coals - Part 5: Method of determining microscopically the reflectance of vitrinite) with measurement of reflectance by greyscale intensity only allowed under the ISO standard. Mean Maximum and Mean Random methods can be carried out by the PIC. The maximum reflectance is the highest value of reflectance obtained when any polished section of a grain is rotated about an axis coincident with the optic axis of the microscope in plane polarised light. Maximum reflectance is the type typically performed by the PIC. Mean random reflectance is the reflectance of a grain in the orientation that it is encountered, that is, no rotation of the stage and measured using non-polarised light.

**Maceral Analysis**

Maceral Analysis is usually considered the primary tool for determining coal type and to classify the various organically derived constituents, that is, vitrinite, liptinite and inertinite. A maceral is the smallest recognizable individual constituent of a coal grain. The coal type is dependent upon the depositional environment of the coal. The test is performed according to the standards AS2856.2 (Coal Petrography Part 2: Maceral Analysis) and ISO7404.3 (Methods for the petrographic analysis of coals - Part 3: Method of determining maceral group composition) and is performed by classifying the maceral under the microscope cross hairs and then proceeding to the next field of view. The volume percent concentration of the various components is determined. At least 500 observations are required for each test. For lower rank coals, the additional use of fluorescence is able to be used for the identification of liptinites. Maceral analysis results can be used to predict the behaviour of the coal upon heating. The percentage of vitrinite is an important parameter for coke quality prediction.

**Coke Microtextures**

Coke Microtexture results provide an estimation of the proportion of fused and unfused carbon within a sample of metallurgical coke, as well as the domain size of the fused carbon (also known as carbon forms analysis). Each domain size can be attributed to a specific rank of vitrinite in the parent coal, so coke microtextures can be used to determine the nature of the parent coal. The PIC conducts coke microtextures using the method developed by Charles Coin as there is no International or Australian standard methods for coke microtexture analysis. In addition to this ALS is currently leading an ACARP project on the subject of coke microtextures, this project aims to review current methods of coke microtextural analysis and suggest a robust method that can be used for coke microtextural analysis of cokes made from coals of all ranks.

**Petrography Research**

The recent purchase of a Zeiss Axioimager M2M expands PIC’s capabilities with state of the art imaging equipment that can perform coal reflectograms as well as high quality imaging of coal and coke samples. The PIC is actively involved in petrographic research with recent projects including:

- Development of coke imaging techniques to identify the structural features of fused and unfused parts of the coke matrix leading to better understanding of factors influencing coke strength.
- Review of coke classification systems with the aim to develop of a uniform standard applicable to Australian and International coals.