

# DISCOVERY THROUGH THE AGES – A JOURNEY OF COAL RESOURCE DISCOVERY IN QUEENSLANDS BOWEN BASIN FROM THE 1960's and The 2000's

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## SUMMARY

Exploration methods, technology and equipment may have changed greatly over the last few decades but still does not replace sound geological principles in making new coal resource discoveries. Starting with a case history of the early big discoveries in the Bowen Basin, Central Queensland, author and co presenter Mr Lex Hansen will provide an overview of the methods, techniques, equipment and successes of exploration during the early 1960's in the Bowen Basin.

Mr Hansen was a member of the team of 3 geologists working for Utah development Company (purchased by BHP Ltd in the 1980's) that made the first big coking coal discoveries in the Bowen Basin extending from Blackwater in the south along the western side of the Basin to Goonyella in the north. The majority of these discoveries are still in production today, some 50 years later.

These are compared and contrasted with a more recent case study involving greenfields discovery's at the Meteor Downs South Project located also in the Bowen Basin Central Queensland. This will provide a unique opportunity to review coal exploration methodology, technology and successes. Co author and co presenter Mr Darren Walker lead the teams responsible for this discovery.

The authors then contrast and compare exploration from the 'then' and 'now' and discuss the importance of 'grass roots' geological field work, data analysis and principles in successful exploration regardless of the perceived exploration or resource maturity of a mineral province. Much has changed in the 60 odd years between the discovery of the world class coking coal deposits along the western edge of the Bowen Basin with the most significant being technology and significant increases in regulation, community expectations and approvals now governing coal exploration in Queensland.

This begs the question as to whether this change has achieved the benefits desired and resulted in further major discoveries, or if it has further hindered the exploration industry and the discovery of the future of the coal resources in Queensland.

**Key words:** Bowen Basin, Geology, Exploration, Beer

## INTRODUCTION

Exploration for earth resources and materials has been a necessity of human life since the early homonoids first learned to exploit naturally occurring materials to fashion the first stone and wood tools some 3.3 million years ago. Understandably the knowledge, methods and tools used to explore for earth resources has changed significantly through time as well and the aim of this paper is to compare and contrast these using the Bowen Basin coal discoveries as a reference point.

The largest and most significant discoveries of coking coal in Australia and in the world were made in the early 1960's within the Bowen Basin Queensland with these discoveries still accounting for the majority of coking coal exported today (World Coal 2017). Mr Lex Hansen was a member of the team of 3 geologists that was involved in the exploration for and discovery of a number of these coking coal resources and provides an overview of what exploration looked like in the early 1960's and how it resulted in these successes.

Moving forward nearly 60 years exploration for coal in the Bowen Basin is very different with all the major discoveries of similar scale resources being made and coal exploration now focussed on smaller scale resources or brownfield extensions to existing operations. Mr Darren Walker was a member of the teams responsible for the discovery of several new coal resources during the last ten years which provides a interesting contrast of exploration in the modern era and particularly how non geological matters such as regulation and stakeholder engagement is a much greater influence on the success of exploration then even grass roots geology.

The paper aims to compare and contrast the different approaches and constraints in the areas of Exploration Strategy, Legislation/ Regulation, Community and Stakeholder Engagement, Methods/ Technology, Equipment/ Logistics and Measuring Success.

## CONTEXT TO BOTH PROJECTS

In the early 1960's the commercial environment that was evolving was one of a growing coal export industry, as the Japanese demand for bulk commodities was increasing rapidly as the country launched into industrialisation. Large deposits of iron ore were being announced in WA and the Queensland Government sought to be part of the growing resources export industry. This resulted in a very supportive environment for the fledgling resource export industry from the Politicians and Regulators who encouraged significant investment in the State.

The Utah Development Company recognised the opportunity that was created for coking coal exploration in Queensland with the benefit of a supportive Government, a rapidly growing steel industry and a ready market in Japan. Once the opportunity in the Bowen Basin was identified it became the Company's focus and in 1961 it gathered a small team of explorations and administrators to start assessing suitable land areas for taking up as exploration tenure.

Fast forward to the first decade of the 2000's and a similar enthusiasm for coal exploration was at hand although for different reasons. The biggest resources boom in Australian history was underway on the back of rising demand from an expanding Chinese economy and on the back of rising commodity prices. The majority of greenfields exploration was conducted by the flood of Junior Explorers into the market. Exploration tenure in the Bowen Basin was being snapped up where ever possible and so changing the focus from geologically favourable tenure to just having a tenure of some sort. Brownfields exploration represented the biggest and easiest opportunity for success and these areas were seen as the most attractive. State Governments did not need to be actively attracting exploration investment but instead faced an issue of dealing with the large increase in active participants and the associated administration of this.

The other major difference during the modern era is the growth in animosity between landholders and resource companies brought on by the decrease in the average size of exploration tenure meaning landholders could face having to deal with a number of resource companies at once with tenure over their property. Animosity and influence was also increasing significantly from the environmental activist stakeholder groups (e.g. 'Lock the Gate' movement) and agriculture (farming) who started to gain greater influence with the Government through their influence on the voting public and the election process.

## EXPLORATION STRATEGY AND METHODOLOGY – EARLY 1960'S

Exploration methodology in the early 1960's was geologically focussed and involved firstly gathering intelligence and information from sources far and wide such as field notes from explorer Ludwig Leichardt (His expedition in 1844/ 1845 through the area noted coal outcropping in the Mackenzie River), gathering and harnessing local farmers knowledge and experience in the area as well as on local water bores, other company exploration results and field mapping through railway/ road cuttings, major creeks and observable outcrops. Aerial photography mapping was also utilised wherever available where GeoBotanic analysis were captured, for example assessing structure/ rock types impact on vegetation. Fossil wood was determined as an excellent marker band in the field as well as other stratigraphic markers with these stratigraphic markers invaluable as geophysical technology such as magnetics, gravity and other methods were not readily available at the time or reliable enough for stratigraphic and structural mapping. Queensland and Australia also had a very active Geological Survey and Bureau of Mineral Resources (BMR) who were engaged in 1:250 000 scale field mapping through the area at the time and were another source of observations and data. Desktop analysis was then undertaken of all the available data with drilling targets identified and then a drilling program was implemented.

The first project that this process was used on was the Blackwater project. The initial target was selected from a local water bore that the property owner identified as having coal in it and air photo interpretation showed the strike of the strata was north/ south. The Old Springsure Coach Road (now inactive) provided drilling access across the interpreted strike of the target strata for the initial drilling program. Drilling sites were located across strike and progressing down dip with open hole drillholes based on the results of the previous hole. In the first Blackwater project drilling program the third drillhole hit soot from the Blackwater seams. Geological cross sections were constructed in the field from previous drilling results and drill holes then planned and sited based from the cross sections based on drill chip analysis and depth interpretation. Wireline downhole geophysical logging was not an available technology at the time.

The initial discovery at Blackwater was made within 3 months of starting the exploration program with the drilling season typically lasting 3 to 6 months. The drilling program then progressed north along strike in a similar fashion with drill lines typically 20-30km apart and the initial drill line was quickly followed up with a PQ diamond coring rig in the later stages of the first years program. PQ core holes were generally located at least once per drilling line with drill core transported and logged at the CREB power station at Rockhampton where there was a coal analysis laboratory that was utilised for sample analysis. The geologists also had access to a portable coal coking kit that assessed coal swell (CSN) and could be used in the field to proximate where the oxidation levels were and if the seams possessed coking coal characteristics or not.

After the initial success in the first half of Year 1 geologists went on to complete exploration work in vacant ground (no existing tenure) further North along strike to determine where future tenure should be taken up. For example towards the end of 1962 Don King and Lex loaded up a ute with beer and took it to some seismic drillers who were drilling seismic holes in a large oil search program North of the Blackwater discovery and tenure. They struck a deal where the drillers would provide access and information on drillholes and take drillchip samples in return for beer. The two geologists would then utilise the portable coal coking kit which enabled the Company to determine the most prospective areas and to the take up tenements in these areas. This resulted in the Utah Development Company

taking a large tenure holding on the western side of the Bowen Basin from Blackwater as far north as the present day North Goonyella Mine where the tenures only ended here as field mapping determined that there was significant overlying surface basalt. The focus of the Company at the time was predominantly on open cut operations.

Field living during the drilling programs was in canvas tents with a kerosene fridge and camp stretchers in field camps with the average field duration being around 3 months for staff and drillers. The nearest towns being Blackwater, Clermont and Emerald supplies were sourced from here as well and supplemented with gifts of meat from the local graziers. Field vehicles involved WWII Jeeps and Landrovers. Rifles and tennis racquets were carried in the field. All Company staff were permanently based at the Blackwater office and shared a Company provided rental property in town where they were located when not engaged in a drilling program or field work.

Community and stakeholder engagement and management was paramount during this time. This was not only a source of geological information and access to land also but medical emergencies were all managed by the local community as well as providing sources of entertainment and social engagement. Field crews and staff actively supported local businesses and engaged with local sporting clubs, social functions as well as supporting landowners through providing access to water bore information and groundwater where available as well as property tracks and road upgrades.

As drilling and results progressed the focus shifted from determining strike continuation of the target coal seams and confirming coking coal characteristics to defining mining constraints, such as high and low wall positions, more detailed coal quality and other data requirements for open cut design. A trial pit involving uncovering enough coal for a trial shipment was also completed in year 3 and 4 of the Blackwater resource area and then in a similar fashion for other resource areas.

The result of this work was the current Mining Leases that traverse the western side of the Bowen Basin and currently account for the majority of the BMA and other major Company's operating mines currently in production or on care and maintenance. Current operating mines that were discovered during this period include Blackwater, Curragh, German Creek, Norwhich Park, Peak Downs, Saraji, Moranbah North and Goonyella Riverside.



*Drilling rig at Blackwater trial shipment site 1963*



*Field Coal Swell Testing Kit – circ 1960*



*Drill Site recreation Tent Blackwater 1963*

## **EXPLORATION STRATEGY AND METHODOLOGY – MODERN ERA**

Coal exploration in the modern era has the luxury of access to significant amounts of data from over 60 years of coal exploration in the area as well as the advantages of significant advances in technology, particularly around harnessing computing horsepower to analyse incredibly large data sets as well as communications and access to expert consultants with large amounts of experience in their fields. The other advantage is the collective experience of decades of production and associated coal sales and research into all aspects of Bowen Basin coal geology, from coal quality and marketing to structural geology and regional scale geological models.

Disadvantages however are many in the modern era compared to the 1960's exploration environment. The biggest of these includes the immense scale of tenure holdings currently across the Bowen Basin with the most prospective ground being held under continuous tenure since the 1960's and virtually every inch of any vacant ground being progressively taken up since the start of the resources boom in the early 2000's. This provides a significant barrier to entry for new participants and an equally significant advantage to the bigger players in the area as well as those with existing tenure. With the majority of ground prospective for coking coal held by the major industry coking coal producers for decades has forced junior explorers to look for coking coal in non traditional areas, such as high ash and low coal washing yield coal seams long considered nothing but waste by the mining industry. It has also put the focus on underground resource areas and low margin open and complex open cut resources with higher capital cost and increased sensitivity to coal price fluctuations.

The other area of significant constraint to modern era explorationists is the consistent Regulatory creep that Federal and State Governments are engaged in, where they are vainly attempting to placate the growing activism by the anti mining movement being led by certain environmental groups as well as the growing frustration and animosity by landowners and local communities. This has resulted in a plethora of new legislation and ever growing regulatory landscape governing coal exploration and mining activities in Queensland. This has resulted in a cultural shift in the strategy, methodology and focus of explorationists from the primary focus being geological principals and selection of ground on the basis of prospectiveness to the primary focus being land access and health and safety with selection of ground based on availability as well as accessibility with geology playing a poor second cousin in the selection of ground.

These restrictions however place an even greater importance on geological thinking and sound geological practices in the exploration strategy once an exploration tenure is acquired. This was certainly the case with the Meteor Downs South Project which is now one of a select few of greenfields projects being currently developed in the Bowen Basin in the last decade.

The Meteor Downs South Project (MDS) is located in the Southern Bowen Basin adjacent to the Rolleston open cut coal mine and roughly 100km south of Blackwater. Currently under development by a Joint Venture between U&D Coal Ltd (with a Chinese State Owned majority shareholding) and Sojitz Corporation (with a majority Japanese shareholding) the project will have taken nearly 8 years to get from discovery to production and at only a 500,000 t/pa start up production rate for the first two to three years of operation and a 16 Mt total reserve it will be on of the smallest and lowest cost operations in the Bowen Basin.

The initial tenure was acquired from another junior explorer in early 2009 on the basis of availability rather than detailed geological interpretation and once acquired the Company quickly set about securing land access for the initial drilling program. A substantial amount of previous exploration had been conducted in the surrounding area with some good datasets available and these were utilised to identify two historical drillholes that appeared to have been terminated prematurely. The identification of these involved the use of powerful GIS computing as well as a desktop review and research to gather all relevant historical information.

An initial drilling program was implemented to test these drillholes with the initial drillholes sited along a public road for ease of access (drilling in road reserves at the time presented a far easier and more timely process then within properties) and the target was a small thermal underground coal resource. The drillholes proved a success with a significant coal seam intersected and the Company was listed on the ASX from the results of these two holes coupled with a substantial tenement holding in order to raise capital to fund further exploration of the tenure.

During the subsequent drilling program for the small underground resource access was obtained to the property's within the tenure through liaison with the relevant landowners and field mapping was undertaken within the tenure. As rights of access now only pertain to the granted tenure exploration was restricted to only the ground within the granted tenure. During this field work fossil wood marker beds (the significance of which extends back to the 1960's exploration learnings) were identified on the surface that matched fossil wood marker bands at the underground project. A scout drill program was put together to identify if coal seams were present at open cut depths after significant liaison with the landholder and agreement on the number of holes to be drilled and the location of sites. The initial program was successful with a 10m thick coal seam intersected and located the same depth below the fossil wood layer as in the underground area.

Progress of a discovery through to definition of economic resource now involves a multistage process completed over years or even a decade or more rather 1 or 2 years as in the 1960's with the increase in timing directly attributed to the significant increase in regulatory processes and approvals required to be undertaken. Due the majority of funding for resource companys now being sourced from public stock exchanges which in turn led to an increasing focus on transparency and disclosure of information regulatory frameworks such as JORC and VALMIN were developed. This then led to regulators also adopting these frameworks for achieving the same aims with exploration and mining tenure applications and grant. As a result changes in regulatory requirements for pre requisite higher level tenure application milestones in Queensland now involve defining and demonstrating resources to a Indicated or Measured status under the JORC code for mining lease tenure as well as the physical area of the resource now affecting the tenure size that can be applied for.

In terms of the resource development for MDS this then led to a focus on achieving increasing levels of JORC resource confidence rather than specific geological or mining engineering requirements. This in contrast to the drilling aims of the 1960's where drill lines were focussed on addressing purely geological or mine design requirements. At MDS subsequent drilling programs post the initial discovery campaign required to be carefully planned based on a review of all available historical data and the results of the initial drilling program as drillholes can no longer be sited on the run due to constraints with land access and prior agreement required with the landowner for compensation calculation and payment purposes. The advent of Native Title has also impacted on the flexibility on drillhole locations

Exploration equipment and technology have also changed dramatically since the 1960's with the modern geologist equipped with portable XRF scanning technology, drill hole logging straight into an electronic device, mobile and satellite phones as well as digital cameras and access to digital information directly in the field. Another aspect that has changed significantly is the abundance and availability of transport and associated infrastructure throughout the Bowen Basin. With the relative convenience of air travel field teams can now be based basically anywhere they choose and travel to the exploration site which has resulted in the advent of the fly in/ fly out work arrangements which have proved extremely popular. Supplies are easily sourced as with vehicle transport and other exploration equipment which includes spares and consumables for drilling operations. Thankfully this also now includes beer supplies, which are still a popular tool now for the payment of favours and coercion for drilling personnel as in the 1960's.

These environmental changes have seen the traditional responsibilities of the coal exploration field geologist change from purely a geological perspective, a prospector, explorer as well as an active and important member of the local community to a transient worker with the primary focus in the fields of administration, company health, safety and environmental representative and simple geological data collector. Modern advancements and availability of geophysical downhole wireline tools have also replaced the need for accurate depth calculations and even seam thickness as geological field drill logs are now later corrected to the geophysical wireline results which along with geological interpretation is completed post drilling program back in the head office.

However despite these changes the critical need for solid geological principals has not changed, just where it lies in the exploration process. Given the constraints and restrictions on available tenure then even more emphasis is on sound exploration geology practices to make the most out of the tenure that is obtained. As in the case with MDS, using as many exploration methods as available prior to starting a drilling program is critical to ensuring that the time, cost and effort involved in getting a drilling program developed delivers maximum value in terms of geological information.



*Drill rig MDS – 2010*



*Site Set Up and Shift Toolbox Meeting – MDS – 2010*

## CONCLUSIONS

Coal exploration in the Bowen Basin has changed dramatically in the last 60 years, as would be expected with advancements in exploration technology, knowledge and experience gained from 60 years of exploration and production in the region. However not all of the changes have been positive for improving exploration success with a significant increase in the amount regulation and statutory approvals required before exploration can even begin on the ground. This ever increasing regulatory environment has impacted on the role of explorations greatly with the majority of time and money now being spent on admirative tasks and processes required just to gain access to the land and can often take up a greater percentage of budget and time for a project. Coupled with the now restrictions on new land availability and even existing tenure availability the need for a high level of geological skills and assessment of ground that is obtained is critical to delivering maximum value from available tenure.

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