VERY HIGH GRADE OROGENIC QUARTZ-AU VEIN DEPOSITS IN THE PERMO-CARBONIFEROUS SLATE BELT, CENTRAL MYANMAR: INDICATIONS OF A REGIONAL GOLD PROVINCE?

Myanmar Geology

- **Western province**
  - Indoburman Ranges fold-thrust belt with Chin flysch.
  - Central Lowlands and Tertiary sedimentary basins with oil-gas fields, volcanic arc with Monywa copper deposits.
  - Western Ranges and Central Lowlands includes northern continuation of Sunda arc.

- **Eastern province**
  - Shan Plateau of Precambrian to Cretaceous rocks with Slate belt and Mogok Metamorphic belt to the west.
  - Eastern province is southeast continuation of Tibet Plateau.
  - Modi Taung (Block 10) lies in Slate belt west of Shan Plateau and east of Central Lowlands.
Block 10
Geology

- Modi Taung mine lease area (40 km²) is within north-trending Slate belt, late Palaeozoic Mergui Group.
- Between the Slate belt and the Central Plain are schists, gneisses and granites of the Mogok Metamorphic belt.
- East of Slate belt, Mesozoic rocks of Paunglaung-Mawchi zone are bordered by limestone scarp of Shan Plateau margin.
- Slate belt intruded by andesitic to granitic stocks, sills and dykes.

Geological Cross-section
Block 10

Regional cross-section through Modi Taung. Location on geology map.
Augen Gneiss in Nattaung quarry

Sedo Granite west of Modi Taung, a 4 to 7 km wide NNW-trending coarse-grained to porphyritic S-type granite probably mid-Tertiary in age. Post-dates veins and dykes.
Yinmabin Schist, Letha Chaung, west of Modi Taung. Quartzite and biotite schist showing chevron folds, axes dip steeply east, looking north. Metamorphosed Mergui Group.

Simplified geological map of Block 10 concession showing location of Modi Taung-Nankwe gold district, NT, Ngapyaw Chaung Thrust; PLF, Pan Laung Fault.
<table>
<thead>
<tr>
<th>Layer Description</th>
<th>Stratigraphic Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bryozoa brachio-pods</td>
<td>POKLO-KKALE</td>
</tr>
<tr>
<td></td>
<td>PEBBLY WACKE</td>
</tr>
<tr>
<td>Quartz-gold veins</td>
<td>KOGWE</td>
</tr>
<tr>
<td></td>
<td>MUD-STONE</td>
</tr>
</tbody>
</table>

Schematic stratigraphic column, Mergui Group, Modi Taung-Nankwe area, showing veins relative to present erosion level. Total stratigraphic thickness about 2km.
Modi Taung Exploration Area

Work Completed, Modi Taung

- Original access by foot.
- Supplies and equipment by porter or elephants.
- 12 km ACCESS ROAD completed February 2002.
- 38 kms SOIL LINES in adit area Jan 2001- August 2005.
- 400 hand-dug TRENCHES (nearly 5 km total length), stream outcrop sampling, mapping.
- 44 SURFACE DIAMOND DRILL HOLES total 7500 metres.
- 11.3 Km UNDERGROUND EXPLORATION ADITS.
- 49 UNDERGROUND DIAMOND DRILL HOLES 40-50 m each.
Work Completed
Access Road – Modi Taung

Logging and district road
- Junction Nyaung Lunt on highway north of Tatkon.
- 23 km dirt road to mine access road
- 9 river crossings on dirt road

Mine access road
- 12 km mountain road
- Climbs 1,100 m. to site.
- Constructed early 2002.
Project History

- Late 1996-99 reconnaissance stream sediment, BLEG sampling, follow-up mapping, outcrop and float sampling. Detailed work focused on Lebyin area.
- Early 2000 surface exploration identified high-grade vein outcrop in Slate belt where lode gold previously unknown.

- Trenching up spur exposed vein continuation
- Short adits gave good width, grade, showed vein texture.
- Subsequent soil sampling, trenching on value spikes, more exploration adits, diamond core drilling.

Modi Taung Geochemical soil grid and trenches (8 km² adit area)

- 38 km soil lines
- 3539 soil augur samples on lines, Au assays.
- 400 hand-dug trenches on soil spikes (approx. 5 km total length)
- Inclined surface diamond drill holes mostly positioned from soil and trench assays.
- 1863 soil samples elsewhere in 40 km² area.
- 4601 soil samples elsewhere in Slate belt.
Modi Taung Adits

- Total adit length 11.2 km
- Longest drive 636 m
  (Shwezin Level 1000)
- Lowest Level 900 m
  (Htongyi Taung)
- Highest Level 1301 m
  (Momi Taung)
Work Completed –
Shwesin Long Section

Looking ENE

Work Completed -
Htongyi Taung Long Section

Looking ENE

Longitudinal profile, Htongyi Taung vein system and Kyauksayit. (August 05)
Work Completed - Adits

- Two major, five smaller vein systems explored from adits.
- 6549 underground channel samples,
- 593 underground panel samples.
- Two stope cuts to test Resue method
- Three 50 to 70 m raises completed

Exploration has concentrated on Shwesin and Htongyi Taung systems. These systems have the best short term potential to define sufficient resources to guarantee capital payback.

Adit Geology - Style Of Mineralisation

- Steeply-dipping quartz-gold veins occur in linear shear zones within slatey mudstone and sandstone.
- Veins are narrow but high grade.
- Average grade of probable mining blocks 23-27 g/t using 100 g/t top-cut (Uncut 42 g/t).
- Grade and width vary widely horizontally and vertically.
- Coarse visible gold in sulphide, predominantly pyrite, seams and webs within vein, fine gold in vein quartz.
- Typical mesothermal slate belt quartz-gold veins.
- Similar style Bendigo-Ballarat Australia.
- Implies continuation of veins to far below current deepest adits.

Htongyi Taung 975m level near portal

Htongyi Taung 950m level laminated book-and-ribbon vein. 77cm@122 to 575g/t below oxide zone. 22S3002N
**Htongyi Vein Intersections**

Htongyi Taung drive, 950m level, mudstone ‘raft’ in laminated vein, 69cm@7 to 36 g/t. 2252916N

Htongyi Taung drive 950m level. Spur veins in sheared mudstone and siltstone. 2252903N

**Shwesin Vein Intersections**

Shwesin vein (right) 70cm@6 to 17 g/t, fine-grained dyke (centre), mudstone wall (left). 2252281N.

Shwesin vein 1200m level looking SE, 80cm@2 to 16 g/t, oxidized zone. 2252238N.
Local Geology - Modi Taung

- Adits within 4.0 km², inside 40 km² mine lease.
- Mine lease occupied in west by Carboniferous slatey mudstones with interbedded sandstones, in east by overlying ?early Permian pebbly mudstones.
- Western adits in folded slatey mudstones and sandstones with local minor intrusions.
- Eastern adits in NE-dipping mudstone monocline.
- Veins are offset up to a few metres on NE-trending dextral and NW-trending sinistral faults.

Schematic plan view of steeply west-dipping Shwesin quartz-gold vein showing pinch and swell of vein in shear zone, later dacitic dykes conjugate cross-faults, and possible late fault within and beyond shear zone. Stress orientation during shearing inferred from reverse fault movement. Modified from Worsley (2002)
ASSYMETRIC FOLD IN FINE-GRAINED SANDSTONE (LIGHT GREY) AND MUDSTONE, HTONGYI TAUNG 950M LEVEL RAIL ACCESS FACE, LOOKING SE. 2253021N.

GENTLY-DIPPING LINEATIONS 15° TO NW ON VEIN SURFACE AND WITHIN VEIN, HTONGYI TAUNG 950M LEVEL, 2253954N.

THE DEVELOPMENT OF AN ELONGATE DILATIONAL JOG

- Fracture Surface
- Fault Movement-Dilation Zone
- Fluids sucked in: minerals deposited
- Alteration and vein stock works
- Mineral vein: original fracture welded shut
- Xenoliths of country rock

TIME
STRUCTURES AFFECTING VEINS

Segment of Htongyi Taung vein on 950m level with relatively low-angle NE dip, 40cm@11 g/t, 2253073N, looking SE. Note ribbons in vein oblique to vein margin.

Near-isoclinal fold in NE-dipping Adder vein in Trench KAE21, looking N. Vein width is 12cm, grade 407.5 g/t and 165.0 g/t.

Local Geology - Petrology

- Coarse visible gold commonly present in veins assaying over 30g/t Au
- Gold not encapsulated in pyrite.
- Gold is frequently observed in hand specimens in both the oxide and sulphide zones.
Local Geology –

Heavy Metals Present in Vein material

**Modi Taung veins**
- Low in Cu Pb Zn Sb, Bi, Cd, Ms, Bi, Te, Hg below detection. As lower the Au at high gold values.

**Kankaung veins** (12 km north of Modi Taung)
- Higher Pb Zn Cu As Ni Cd

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### Sample And Assay Procedures

**Adit Sampling – Example Crosscut**

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### Modi Taung samples, average metal values (20 samples)

<table>
<thead>
<tr>
<th>Average Au in range</th>
<th>Average value for gold range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mo</td>
<td>Cu</td>
</tr>
<tr>
<td>above 100 ppm</td>
<td>224</td>
</tr>
<tr>
<td>100 - 20 ppm</td>
<td>53</td>
</tr>
<tr>
<td>below 20 ppm</td>
<td>6.0</td>
</tr>
<tr>
<td>All (20 samples)</td>
<td>48.1</td>
</tr>
</tbody>
</table>

### Kankaung samples, average other metal : Au ratios

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<tbody>
<tr>
<td>Mo</td>
<td>Cu</td>
</tr>
<tr>
<td>above 100 ppm</td>
<td>311.3</td>
</tr>
<tr>
<td>100 - 20 ppm</td>
<td>49.9</td>
</tr>
<tr>
<td>below 20 ppm</td>
<td>3.4</td>
</tr>
<tr>
<td>All (20 samples)</td>
<td>120.3</td>
</tr>
</tbody>
</table>

### Kankaung samples, average other metal : Au ratios

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- Highly variable veins that are sometimes absent, but always unpredictable in both width and grade.
- Resource cannot be defined by diamond drilling. Too narrow and variable. "Drill for structure and drift for grade.”
Resource Estimation Polygons - Shwesin 1000

Htongyi Taung three-vein system and adits. 3D view from Surpcaac model looking north west.
Htongyi Taung Mineralisation
Long Section Vein 3

Geostatistics

Histogram & Cumulative Frequency of Shwesin Vein Width

Natural Log Histogram of Shwesin Vein Composite Assays
Resource Estimation- Polygons

- Individual high grade samples assaying above 100 grams/tonne, are cut to 100 gm/tonne.
- Continuous high grade areas identified along strike, assays and widths averaged within polygon
- Polygons extended along strike within high grade area.
- Polygons extended 12m above and below each level
- Polygons not extended below lowest level

<table>
<thead>
<tr>
<th>Vein System</th>
<th>Total strike (m)</th>
<th>Stope strike (m)</th>
<th>ave. width (cm)</th>
<th>Uncut ave. grade (gm/tonne)</th>
<th>UNCUT ave. grade (gm/tonne)</th>
<th>Cut ave. grade (gm/tonne)</th>
<th>Cut ave. cmq</th>
<th>Cut ave. grade (gm/tonne)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shwesin</td>
<td>2,482</td>
<td>918</td>
<td>37</td>
<td>52</td>
<td>1,920</td>
<td>30.6</td>
<td>1,389</td>
<td>26.6</td>
</tr>
<tr>
<td>Htongyi</td>
<td>1,008</td>
<td>1,058</td>
<td>29</td>
<td>31</td>
<td>896</td>
<td>21.9</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>3,490</td>
<td>1,976</td>
<td>33</td>
<td>42</td>
<td>1,389</td>
<td>26.6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Resource Estimation- ID² Surpac

Resource
- ID² method
- Top Cut 100g/t
- 12 g/t cut off
- Confined to Geology (vein true width)
- Confined between 937.5 RL and 1052 RL

Reserve
- Confined to lowest development level, topography or 12.5m above upper most level.
- Confined to Stope-able outlines
- Dilution 15%, Recovery 90%.

Resource/Reserve Estimation Using ID2 Surpac Method (March 2005)

<table>
<thead>
<tr>
<th>Mineral Resources (above 12g/t)</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tones</td>
<td>Gold (g/t)</td>
</tr>
<tr>
<td>d&lt;12.5m</td>
<td>36.710</td>
<td>36.56</td>
</tr>
<tr>
<td>12.5m&lt;d&lt;30m</td>
<td>29.860</td>
<td>32.10</td>
</tr>
<tr>
<td>Total</td>
<td>66.570</td>
<td>35.69</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Ore Reserve</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tones</td>
<td>Gold (g/t)</td>
</tr>
<tr>
<td>d&lt;12.5m</td>
<td>30.087</td>
<td>25.03</td>
</tr>
<tr>
<td>12.5m&lt;d&lt;30m</td>
<td>24.286</td>
<td>22.40</td>
</tr>
<tr>
<td>Total</td>
<td>54.373</td>
<td>47.43</td>
</tr>
</tbody>
</table>

Mining Method- Resue Stoping

Advantages
- Filled method, resulting in geotechnical stability and no caving
- Minimum possible stope spans, reducing ground support requirements
- Allows maximum recovery of enriched ore close to surface
- Filled stopes allow the use of exploration drifts in HW or FW for access.
- No temporary or permanent pillars, no lost high grade ore
- Very flexible, can follow variable vein dips, vein thickness, splits, convergence, parallel or absent vein
- Minimum dilution of ore
- Labour intensive method, complementing the low labour cost

Disadvantages
- Narrow vein results in only 5 tonnes of high grade ore per face, therefore minimum 15 faces for 75 tonnes per day.
- Production limited to 75 tonnes per day high grade mill feed by need to maintain sufficient producing faces.

Most of the mine will be resue stoping, local wide vein (approx 0.9m) in good ground could be shrinkage, with development waste fill.
Production Rate

- Mill feed 75 tonnes per day
- High grade mill feed
- Rate recommended by independent narrow vein mining consultant
- Narrow 30cm vein would require approximately 8 stopes, 15 working faces to feed the mill.

Core drilling, Htongyi Taung 950 m Level cross-cut.

Mining Method- Development

- Exploration aditing, Shwesin 1050m level, 57cm vein in oxide zone.
- Exploration Aditing- Airleg drill and blast (1.6mx2.0m), hand mucking ½t mine car.
- Main Haulage Htongyi Taung Airleg drill and blast (2mx2.5m), pneumatic overshot loader, 1 t mine car, battery loco.

Overshot loader, Htongyi 950m rail haulage.

Portal and locomotive, Htongyi 950 rail haulage.
Metallurgical Testing

Testwork on oxidised, non-oxidised high and low grade samples by IML, Perth (4 testwork batches):

- Responds well to gravity concentration, gold recoveries 25 to 40 %, confirmed using optical microscopy.
- Responds well to cyanidation (oxide and non-oxide, with or without gravity) gold recoveries 96 %.
- Responds reasonably well to gravity concentration followed by flotation, at rougher stage 88 to 92 %.

- Recent tests indicate 95% recovery with gravity - flotation concentration at a grind size of 75um.
Late orogenic (mesothermal) quartz-gold veins. Sandstone-shale sequence (A) is compressed and folded (B) during orogeny. Deforming rock packet extends both up and down relative to neutral sea level. In (C) descending lower part of rock column is metamorphosed, dehydration water ascends up faults or shears, and cools, depositing gold in "gold window" around 280° to 400° C in brittle-ductile zone. With erosion and cooling of upper part of column, base of brittle zone descends to below top of older veins while mineralization continues in gold window below brittle zone. (gold window from Pettke et al 1999.)

Veins are younger than peak metamorphic minerals in host rock, so host rocks in gold window are cooling and ascending.

SYN-OROGENIC
Map of part of Myanmar showing gold prospects and deposits and tin and tungsten deposits.
THANK YOU!